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RATES FOR HYDROELECTRIC POWER.

The article by Mr. Alton D. Adams printed elsewhere gives an instructive statistical view of the amount and price of sales of energy made by various hydroelectric systems to large consumers. As our readers well know, the great developments in energy transmission in the last few years have been in the direction of wholesale supply of energy. The transmission system working over many hundred square miles of territory is seldom inclined to undertake a general distributing business throughout its entire territory, for much of this territory is already occupied by electric lighting and power plants and the places served by these cannot usually be reached by the transmission company without a fight costly both at the start and in competition afterward. As a rule, therefore, the transmission company makes as fair terms as it may with local distributors and furnishes them with energy at wholesale rates. In the case of single large industries or communities as yet unsupplied with energy, it may also take up the sale of energy directly to the consumer. In such instances, as Mr. Adams shows, the rates may be even lower than the public-service corporations'. It is proper enough that wholesale rates should be made to those charged with the burden of distribution, but from the standpoint of ordinary rate-making it is not obvious that sales to private consumers at a lower rate even for smaller amounts of energy are defensible. An electric supply corporation serving any given community is generally recognized as a natural monopoly and as such subject to a considerable degree of local control. Nobody wants two or three competing systems in a given territory, with their separate systems of pole lines and methods of service, particularly in view of probable amalgamation later, leaving the town bristling with poles and without the lower rates which exist temporarily only so long as competition lasts.

Bearing this in mind and recognizing the fact that public authorities should look after the interests of the public which they serve, the question naturally arises why electric energy transmission companies should be permitted that discrimination in rates which is denied to the company which operates locally. One asks with considerable interest why it is that individual private consumers are sometimes able to obtain from transmission companies much better rates than public-service corporations. Of course, in certain instances this difference may be a very proper one, due to radical difference in the nature of the service, but it does not appear that such is always the case. The long and short of the matter is that transmission companies appear to be doing now the very common thing which the supply companies did twenty years ago; that is, they charge what the traffic will bear. There is much to be said, commercially speaking, for this point of view. It practically implies furnishing to each consumer energy at a rate which seems a good thing from the consumer's point of view, for if a large consumer, whether a private individual or a corporation, cannot see profit in taking electric energy, he is not likely to take

it. However, this very principle of charging what the traffic will bear is one that has practically been legislated out of existence as regards public electric supply corporations, proceeding on the principle that all of the community are contributors to the charter rights under which such corporations conduct their business.

It is now pretty universally held that supply corporations must conduct business on as nearly the one-price plan as is practicable, that they must have a schedule which metes out even-handed justice to all comers. This is good equity considering the supply corporation in its rôle as a public servant, although this principle is sometimes carried too far. But this sort of discrimination, which is forbidden to the retail electric company, is winked at or openly permitted in the case of the wholesale electric company. It must be somewhat discouraging to a small electric light company to see a private corporation near by buying energy at a lower price than central-station cost even when it presents load conditions not more favorable to the generating plant. The situation is a difficult one to meet, but from the standpoint of the larger public it needs investigation. There is something to be said for the right under proper restrictions of making special contracts, but it is a thing not likely to be encouraged. If it is proper to require a local supply company to sell at a uniform rate or with a certain definite schedule of discounts within a single municipality, then why is it not proper to apply a similar ruling to the case of the large electric supply corporation that operates over several counties?

This question has never been fully answered, nor is it likely to be in the near future. The tendency is to conserve as far as possible the rights of the ultimate consumer, and on this principle the propriety of charging higher rates to users of wholesale energy than charged at retail directly may well be open to question. On the other hand, there is no doubt, considering the nature of hydroelectric load, that undue obstacles should not be put in the way of securing paying load whenever it can be found. The difference between the hydroelectric plant and the ordinary station is perhaps chiefly in the fact that the fixed charges in the former case are relatively much greater as compared with operating expenses than in the latter case, the fixed charges hence varying little with the load. The mere fact that an energy-transmission plant takes on a large consumer at a rate apparently absurdly low may justify it also in reducing prices to other consumers. If a hydraulic plant can secure a large amount of electrochemical business even at a very low figure it may go so far toward paying fixed charges as to wholesale energy for lighting purposes at decreased rates. The difference between the hydroelectric company and the ordinary station in this particular is, of course, one of degree rather than kind, for the same argument applies to taking on large consumers within the limits of service of an ordinary supply company. All one can say at the present time is that it looks very much as though some general examination into these questions of rates must soon be made. A final settlement will doubtless have to come by intelligent general regulation of rates, not directly according to any so-called scientific system of rate making, but according to the fundamental principles of a square deal, in which we are happy to say electric supply companies and the public are now disposed to co-operate without friction.

CENTRAL STATION ICE MAKING.

A recent inquiry from this office shows that 105 central stations manufacture ice as a by-product. In addition there are 122 central stations throughout the South which have the word "Ice" in their corporate name. How many of these may have followed the fashion set by central stations which included "Heat" in their corporate name will later be determined. It may, however, be assumed that there are not far from 200 central stations that have taken up ice making as an auxiliary to electric lighting and we have known of no case in which, once taken up, a station has abandoned that extension of its activities. During the past several years a number of articles have appeared in these columns descriptive of central stations that have embarked in ice making, and in every case the result has been highly satisfactory. We shall continue our investigations into this branch of central-station work, but the time is now gone by when any special demonstrations should be necessary to convince the enterprising manager of an electric lighting plant of the possibilities of ice making as a central-station auxiliary.

That, after all of the talk in recent years about the desirability of straightening the load curve, central-station ice making has not made more progress is at first sight not a little surprising. When, however, we look back and reflect on the many weary years that it took to instil the idea of a motor load into the central-station consciousness and the apparently hopeless status of the flatiron and other electric heating devices during a long-drawn-out period, it appears that the popular idea of electrical progressiveness requires some qualification. Moreover, in the past the larger central stations have been looked to as leaders, the smaller ones waiting upon them to try out new things. In the present case the subject is one that affects specifically the smaller stations, and leadership in the development cannot be awaited from the upper ranks. Little time and trouble will be involved in central stations making individual investigations of the subject. Refrigerating machinery suitable for central-station application is now offered by a number of manufacturing companies, any one of which would doubtless be happy to supply information to a central-station inquiry; and as a matter of comity most plants now having an ice-making auxiliary would not refuse to answer reasonable questions as to their experience.

Where ice making is conducted as a separate enterprise it is almost invariably a money-making proposition. In fact, as a strictly business proposition an owner of an unprofitable electric lighting station would, in almost any town of moderate size, be often justified in using as a basis for an ice-making plant such of the equipment as would be suitable and scrapping the purely electrical equipment. Aside from the larger central stations, an ice-making plant is almost a natural part of an electric lighting plant owing to seasonable conditions. Added to this are the economic principles that come into play in such a combination, whereby favorable conditions as to load curve enable better terms to be made for electric lighting, thus leading to the extension of the original business. Even in the far North, experience has shown that competition of natural ice is not an obstacle, for the manufactured product always receives the preference and usually can be furnished at a price that will sooner or later discourage ice harvesting. Moreover, experience has further shown that where a supply of good artificial

ice is always available the ice-using habit is quickly formed in a community and constantly grows, so that it is an exceptional town where risk would be involved in the establishment of such a plant on the score of probable lack of demand for the product. These by no means exhaust the arguments favoring the ice-making auxiliary, but appear to be sufficient to justify the central-station manager in making a personal investigation in detail of a subject that has come permanently to the front.

CONSTANT-VOLTAGE VARIABLE-SPEED GENERATOR.

Of the many schemes that have been proposed for obtaining a constant e.m.f. from a generator driven at widely varying speeds, one of the simplest is noted in the Digest in this issue. Use is made of a separately excited generator, the field strength of which increases as the speed decreases, having zero value at a certain very high speed and a certain high value at zero speed, and changing regularly from one value to the other with change in speed. Since the armature e.m.f. of a generator is directly proportional to the product of the speed and the field strength, it follows that for constant armature e.m.f. the field strength should vary inversely with the speed; that is, the field should reach infinite value at zero speed and zero value at infinite speed. With speeds plotted as abscissas and field strengths as ordinates the required curve becomes a hyperbola, while the curve obtained according to the scheme mentioned in the Digest is a straight line. It is evident, therefore, that constant e.m.f. at all speeds is not obtained. However, both the position and shape of the straight line can be altered at will, so that it may be caused to intersect the hyperbola at any chosen two points. When these two points are sufficiently close together, the deviation of the hyperbola from the straight line between these points and beyond them for a limited range can be kept within a small percentage. That is to say, the generator can be caused to deliver the desired e.m.f. at a high speed and at a low speed, to produce a slight excess of e.m.f. at intermediate speeds, and a deficiency of e.m.f. at speeds either above or below the range here indicated. It is stated that with a ratio of speed of two to one between the highest and lowest the voltage variation does not exceed 6 per cent above and below the average e.m.f.

RAILROAD STATION LIGHTING.

Electric service companies supplying energy for lighting within populous districts of extended area sometimes look to railroad station illumination as a field for exploitation. The average revenue to be derived from a single installation of this kind is small, but it is apt to be gained from a somewhat diversified use of the company's facilities, and is therefore desirable as a means of widening the lighting demand on the system. The tendency of many transportation companies is to economize to the harshest limits in station lighting; but as the quality and quantity of illumination rise in public buildings to standards representative of modern electrical practice, the public will surely call for improved lighting at all the more important railroad stations within easy reach of central-station service. The superior illumination of suburban trolley cars is another factor which will force the railroads sooner or later to provide facilities for reading and familiar conversation some degrees better than are evidenced in the makeshift installations still common. An Esquimau ice hut owner might well be ashamed of the facilities provided in not a few modern railroad stations within a quarter of an hour's ride of large city terminals.

Good service in railroad station lighting calls for long-hour use of lamps in the waiting-rooms and on the platforms, stairways and passages. Baggage-rooms, express offices and freight stations are in operation in many cities and their suburbs until 11 o'clock or 12 o'clock every night except Sunday. It is true that many station agents are obliged to cut off energy from the platforms the moment a train leaves, and the ticket office lighting is sometimes switched on while the passenger buys his transportation and turned off immediately afterward. Even if the platform illumination has to be reduced by one-half, however, that of the waiting-rooms deserves to be constantly maintained until the station closes for the night, and at such a standard that one can read without eye strain. The business ought to be practically continuous throughout the evening except in the case of country stations, and for this reason it is desirable even though moderate in volume at each installation. The co-operation of suburban improvement associations might be helpful in securing this sort of business in cases where the policy of the transportation company is so niggardly that the real benefits and economies, as well as the traffic-attracting power, of good electric lighting are not appreciated. The kerosene lamp and the gas lamp should be banished from railroad stations within reach of central-station service. In few other ways can the transportation companies so easily increase their stock of public good will.

GLARE IN ILLUMINATION.

Of the many problems in illumination that are now receiving consideration none is of greater importance than that relating to the detrimental effects of light upon the eye. Whatever may be his opinion of the conditions under which light may injure the eye and the prevalence of these conditions, no one will deny that to the extent that such conditions can be eliminated or minimized without involving extra cost or impairing the "efficiency" steps should be taken with this object in view. Doubts may exist in the minds of some as to the injury to the eye that may be caused by "glare," and not all will agree upon the limit within which glare may be considered not to exist, but every one will admit that when all signs of glare can easily be avoided it is advisable to do so. One of the most encouraging features of the problem relating to glare, and the one to which most of the present-day agitation can be attributed, is the fact that the illumination obtained from a certain lighting installation is rendered much more effective, and hence seemingly more "efficient," when glare is avoided.

The most common example of glare in artificial illumination exists with arc lamps mounted on low posts for street lighting. Although it is known that the foot-candle illumination obtained from arc lamps used for lighting extended areas is independent of the mounting height, yet in the lighting of streets, which represent long areas of limited width, the foot-candle illumination increases at a rapid rate as the lamps are placed nearer and nearer the street surface. To this fact are due the low mounting heights frequently seen. If the criterion of street illumination were ability to see objects at considerable distance along the street rather than merely the density of light flux as meas-

ured by an illuminometer, considerable changes would be made in the usual mounting heights, and by this means much of the effect known as glare would be avoided. In time possibly legislation will be enacted with the object of removing all glaring lamps from the range within which they are annoying to the eyes of the public. It is fortunate for such a movement that all parties concerned will be benefited by a change in the direction indicated.

Recent experiments tend to indicate that when the lamps are without the direct range of vision by an angle of from 15 deg. to 30 deg. the glare effect is negligible so far as concerns the "efficiency" of illumination. From the standpoint purely of ability to see an object, it is probable that a lamp separated by not less than 25 deg. from the object viewed would have a negligible effect upon the sight, assuming the vision and mind to be concentrated on the object. However, when there are glaring lamps in any position where they can be viewed, they prove attractive to the eye, and the "after image" formed upon the retina as the lamps are seen seriously interferes with the subsequent effective vision of the illuminated objects. Opinions differ as to the brilliancy which may cause injury to the eye, but there seems no doubt that the detrimental effect of glaring lamps upon the ability to see is properly minimized when the lamps are removed from the direct field of vision and the brilliancy is reduced to such a value that no after image can be formed.

While legislative action with reference to glaring lamps would doubtless be confined to the lighting of streets, parks and public buildings, yet it is to be noted that the crime of the glaring lamps is quite as prevalent in domestic as in public lighting. Moreover, it is not improbable that the detrimental effects of improperly equipped and used lamps upon the eyesight are much greater in interior than in exterior illumination because of the time element involved. In exterior lighting the conditions as viewed by one person are continually changing, while the interior lighting conditions affect advantageously or disadvantageously each individual for considerably extended periods. Thus, a single improperly equipped reading lamp may be the cause of permanent injury to the eyes of a whole family. There are many methods for minimizing the glare effects in interior lighting. Possibly the placing of the lamps well out of the direct line of vision and suitably reducing the brilliancy to eliminate after images is as good a plan as any that can be stated in simple language. In any event, it is safest never to make use of clear-bulb metallic-filament lamps, and to employ an eye-protecting reflector with an incandescent lamp and place the lamp where the light cannot reach the eye either directly from the unit or by reflection from any smooth surface.

THE HISTORY OF THE LOGARITHMIC SLIDE-RULE.

It has been said jocosely of pins that they have saved thousands of lives by not swallowing them; but it has been said earnestly of logarithms that they have doubled the effective lives of astronomers. The first publication of logarithms was by their discoverer, Napier, in 1614, but their practical importance was so soon recognized that Briggs published a 14-place table of them between the numbers 1 and 20,000 in 1624, or ten years after the first publication. It is curious that the early tables of logarithms, like that of Briggs, were carried to a high degree of precision, such as fourteen significant figures. As time went on the logarithms shortened, until nowadays we rarely see tables of more than seven places. Still more remarkable is the fact that the great bulk of the modern use of logarithms is mechanical use, with the aid of slide-rules, on which are engraved logarithm scales, and which are usually equivalent to three-place logarithms. Thus, taking the 50-cm (20-in.) slide-rule, the longest usually constructed in one straight length, the easy limit of precision is 0.1 per cent, and the logarithmic scale is usually engraved on the slide to divisions of ½ mm, or 1000 in all. This degree of precision is ordinarily attainable with care, but without much difficulty, on a 25-cm (10-in.) slide rule. The slide rule is in very extensive use among engineers and applied scientists, although very little among pure scientists. This is for the reason that engineers are frequently satisfied if they can obtain, quickly, numerical results that are reliable to a few tenths per cent; and that the 25-cm slide rule meets this requirement. Pure scientists usually aim to secure the highest attainable degree of precision.

A history of the slide-rule has recently been published, from which it appears that Prof. Edmund Gunter, of Gresham College, London, brought out a rule in 1620 on which a logarithmic scale was marked off in a single straight line. With the aid of a pair of compasses additions or subtractions of distances could be made along this line, and the corresponding multiplicative or divisive results obtained. The sliding feature seems not to have been added to the rule until 1657. A great number of different types of slide-rule are now in use. A few of the more complex types attain the dignity of five-place logarithm tables, or give four significant digits in a multiplication, with a shrewd guess at the fifth into the bargain. Slide-rules are used in a great number of applications, and many different species have been engraved for special adaptations. In Germany one regular species is much used for electric wiring calculations. Among other special types may be mentioned those engraved for hydraulic engineers, lumber measurers, illuminating engineers, mechanics, barrel gagers, etc. One comfort derived or derivable from the pocket slide-rule by non-mathematical users is that by its use they use their logarithms unconsciously and unawares; or, like Coleridge's ancient mariner, they "bless them unaware."

THE LIGHTING OF SCHOOLS.

A recent report from a medical adviser of the London County Council deals with the necessity of closer attention than is generally paid to school lighting. Much in the report will be commonplace to the illuminating engineer, but certain things are brought out which are well worth comment. In the first place, it is very gratifying to note that in the London schools investigated the daylight illumination furnished more cases of lighting classified as "fair" and "bad" than did the artificial illumination. In a number of schools the daylight illumination was found to be altogether unsatisfactory, and it is specially to be noted that certain rooms showed in daylight illumination dark regions in which the hygienic conditions as regards lighting were thoroughly unsatisfactory. Of the greatest interest perhaps is the comment upon the direction of lighting. Dr. Kerr, the author of the report, paid special attention to the effect of lighting from the wrong direction, and showed that under this condition pupils were apt to sit in cramped and uncomfortable

positions, sometimes developing tendencies toward spinal curvature in addition to the familiar ocular troubles from straining due to convergence and accommodation in trying to get near enough to the work to see it properly. Dr. Kerr goes so far as to lay down a general rule that no classroom should be lighted from behind the scholars, since this position is productive of very troublesome head and hand shadows. To avoid these the children often twist themselves into cramped positions and work under very serious disadvantages.

This rule is upon the whole a very sound one for schoolroom illumination if coupled with the caution that the lighting should not come from a point too far to the front or side. Its fundamental purpose is to avoid head and hand shadows, which are certain to be produced if the general illumination comes from the rear. In this connection it is worth noting that both the London authorities and the Boston (Mass.) authorities, who have investigated this subject in the past few years, concur in recommending a general direction of artificial lighting which, while coming from lamps placed near the ceiling, was given by the location of these lamps in a general predominant direction slightly from the left and slightly from the front. The lamps to secure this result, which was reached independently by the two sets of investigators referred to, are placed unsymmetrically with respect to the axis of the room, being shifted several feet to the left and several feet to the front of the position which would make them symmetrical over the desk area. The shift to the left tends to avoid throwing the shadow of the hand upon anything being written. The shift to the front avoids the head shadow. There is thus a logical reason for the rule laid down by Dr. Kerr.

This same line of reasoning applies to light furnished for general illumination in rooms occupied for various clerical purposes. One cannot take advantage generally in such places of an asymmetrical position of lamps, but one accomplishes the same result by proper placing of the rows or groups of desks. If a room for clerical work is to be definitely furnished with lighting for this purpose, a symmetrical placing of the lamps can be easily carried out; but since as a rule the outlets are located before the use of the room is fairly determined, there is nothing to do but to arrange the desks so as to take advantage of the light available. This can generally be done with very little trouble if the occupants will pay attention to the direction from which the light is coming and are willing to sacrifice an entirely needless symmetry in arrangement in order to gain good and effective lighting.

STANDARDIZATION OF ELECTRICAL PRACTICE IN MINES.

As recently noted in these columns, the Bureau of Standards has issued a circular on the Standardization of Electrical Practice in Mines, containing a number of proposed rules for the installation and use of electricity in mines. The history of the action is printed in the circular, and, briefly, is that the American Mining Congress held last year at Denver appointed a standing committee on the above subject, and the Bureau of Standards was invited to take part in the work. The circular under consideration is virtually a preliminary report on the work of this committee. The standing committee was appointed because the use of electricity is rapidly extending in mining, and the standardization of its use is rapidly becoming necessary. It was desirable, therefore, that the work should be taken up on a comprehensive and national basis. The use of electricity in mines has important relations to life and property in mining operations. Its use may be attended with marked benefits both to the property and to the miners. Mules can be replaced by electric traction machines with a great increase in effectiveness, cleanliness and output. Incandescent lighting can replace oil lighting with marked improvement in effectiveness, convenience, safety and ventilation. Electric blasting can replace time-fuse blasting with increased convenience and safety. But although electricity can be used in these and in other directions of mining work with a reduction in hazard of all kinds, yet, if the electrical installation is carelessly made, or abused, there may be in its use marked danger of fire to the property or of shock to the men. It is, therefore, important that reasonable and elementary precautions of a nature obvious to those accustomed to electric installations should be insisted upon when introducing electricity into mines.

An instance of this kind is narrated by an engineer who has spent much time in installing electrical mining machinery. A certain miner of considerable practical experience and good average intelligence, but of limited electrical experience, remarked one day that electricity, although very useful in a mine, "was very hard on the teeth of the mules." It seems that a mule in the mine had chanced to receive an electric shock and, under the straining influence of the shock, had bitten on the tram rail with sufficient force to break a tooth. The man, having witnessed the event, had arrived at the conclusion that this was a regular incident in electric mine working and a casual property of the electric current. The unfamiliarity in these matters does not, however, lie entirely on the side of the miner. The physical conditions of life underground are distinctly different from those on the surface. Electrical men accustomed to surface work are apt to forget how damp everything becomes underground, how easily grounds occur within apparatus in such surroundings, and how readily a severe shock may be received from relatively low voltages when the apparatus, as well as the hands, feet, and clothing of the miner, are wet. All sets of mining regulations governing electrical installations must specify certain conditions under which the installation shall be made and maintained; but more important than such regulations is the regular inspection of such installations by a competent practical inspector, and the requirement that when electricity is used to any considerable extent in a mine the electrical equipment shall be placed in charge of a competent man who possesses sufficient knowledge and experience to enable the work to be carried on without risk. We are glad to see that the proposed rules call for such inspectors and mine electricians, and that they are also conservative in mandatory provisions. In mining, as in every other walk of life, the fewer mandatory rules we can comfortably work under, the better for all persons, as well as for the rules. A list of the mining electrical regulations in various parts of the world is printed in the circular, as an appendix. They include rules made in West Virginia, Ohio, Idaho, Montana, Missouri, Kansas, Pennsylvania, Great Britain, Belgium and New South Wales. The most voluminous rules in the list are those of Great Britain, and the briefest are those of Kansas, the latter occupying about two lines and thirty-one words of text. Kansas legal enactments have not always been so terse. The circular has been widely circulated by the Bureau of Standards with the expressed invitation to send in suggestions or criticisms upon the proposed rules.

New President of Western Union.

As a result of the purchase a year ago of the control of the Western Union Telegraph Company by the American Telephone & Telegraph Company Mr. Theodore N. Vail, president of the telephone company, was elected president of the telegraph company on Nov. 23. The retiring president, Col. Robert C. Clowry, continues as a director and a member of the executive committee of the Western Union Telegraph Company. Another change in the management of the Western Union company was the election of Mr. Newcomb Carlton, formerly vice-president and general manager of the British Westinghouse Company, as vice-president, to fill the vacancy caused by the resignation of Mr. George J. Gould at the annual meeting last October.

The retiring president was brevetted lieutenant-colonel by President Johnson in 1865 for meritorious service as superintendent of the Southwestern telegraph lines during the civil war. He had begun his apprenticeship as a telegrapher with the Illinois & Missouri Telegraph Company in 1852 and became manager of one of that company's offices. When he was twenty-one he was superintendent of the St. Louis & Missouri River Telegraph Company. After the war Colonel Clowry rose rapidly in the Western Union Telegraph Company, holding one official post after another until in 1902 he was promoted to the presidency.

The new president was born on July 16, 1845, in Carroll County, Ohio. In 1866, when he was twenty-one years old, his family moved to Iowa. The Union Pacific Railroad was then in process of construction and the young man obtained a position as telegraph operator and station agent at small points west of Omaha. Through the friendly offices of Gen. Grenville M. Dodge, chief engineer of the railroad, Mr. Vail obtained an appointment in the United States railway mail service in 1869. In seven years he was in Washington as general superintendent of the entire railway mail service, which he reorganized and improved to a high state of efficiency.

In 1878 Mr. Vail took hold of the telephone and developed the invention of Bell, as his uncle, Mr. Alfred Vail, had done forty years earlier for the invention of Morse. Bell and his associates were looking for a practical man to become business manager and builder of the telephone system. They asked Mr. Vail to take the place. He resigned from the government service and began to work on the structure that stands to-day as the American Telephone & Telegraph Company, with its associated companies. He retired from active service for a time, but was recalled by the stockholders of the telephone company about four years ago to reassume his post as president. Now as head of both the American Telephone & Telegraph and Western Union Telegraph companies Mr. Vail is mapping out a still broader field of work along the line of the transmission of intelligence.

Annual Report of North Shore Electric Company.

For the fiscal year ended Sept. 30, 1910, the gross earnings of the North Shore Electric Company of Chicago were $1,386,062. The net earnings were $478,506 and out of this amount $80,000 was set aside for special depreciation reserve, $212,323 was paid for bond interest and $143,431 for dividends, leaving $42,752 to be carried to surplus, the total of which now stands at $197,651.

The amount of capital stock outstanding and subscribed is $4,964,000 and the amount of bonds issued is $4,705,000. The depreciation reserve under the terms of the company's mortgages stands at $347,640. The total assets are $10,705,432, of which plants, real estate, franchises and construction constitute $9,414,020.

Mr. Samuel Insull, the president of the North Shore Company, remarks that the increase in connected business during the year was more than double that of any previous year, and the increase in gross earnings was much the largest in the history of the company, notwithstanding the fact that the full benefit of new properties acquired was not received during the year. The number of 16-cp equivalents connected on Sept. 30, 1910, was 453,238, compared with 309,786 the year before.

Mr. Insull notes that during the year the company has extended its system into the lake district of northeastern Illinois and that the entire territory now served is approximately 1284 square miles. There are four generating stations and eight substations.

During the year an increase of the capital stock from $5,000,000 to $7,000,000 was authorized, and new stock to the amount of $964,000 was issued. The bonded indebtedness was increased $705,000 during the year.

For the purpose of retiring its 5 per cent first mortgage gold bonds and providing adequately for further financing over a long period of years, the company has made a new mortgage called a first and refunding mortgage, and during the year it has issued under this mortgage $1,981,000 of bonds, retiring therewith $1,976,000 of first-mortgage bonds and $5,000 of other outlying liens. The annual meeting of the stockholders was held on Nov. 28.

Annual Report of Commonwealth Edison Company.

At the annual meeting of the Commonwealth Edison Company in Chicago on Nov. 28 President Samuel Insull presented his report for the year ended Sept. 30, 1910. The earnings and expenses for that year were as follows:

Gross earnings (including merchandise sales)		$13,083,724.59
Expenses (including depreciation and cost of merchandise sales)		8,441,883.16
Earnings for the year		$4,641,841.43
Charges against earnings:		
Interest on bonds	$1,266,918.01	
Depreciation reserve	532,089.00	1,799,007.01
(Under the terms of the mortgages made by the Chicago Edison Company and the Commonwealth Electric Co.)		
Available for dividends		$2,842,834.42
Dividends paid		1,847,243.93
Balance carried to surplus		$995,590.49

For comparison it may be noted that the gross earnings for the year ended Sept. 30, 1909, were $10,639,446.50 and the net earnings $3,996,752.83. The increase in gross earnings during the year amounted to $2,444,278.09, which is approximately double the increase in any previous year in the history of the company. The total charges against earnings in 1909 were $1,609,756.63, leaving available for dividends $2,386,996.20.

On Sept. 30, 1910, the total capital stock issued or subscribed amounted to $32,721,897.50 and the total bonded indebtedness to $27,635,000. The depreciation reserve (under the terms of mortgages) is $2,753,839 and the surplus on Sept. 30, 1910, was $3,025,407.19. The total value of the assets on that date was $67,847,438.34, of which $63,643,076.38 was value of plants, real estate, etc.

In his report Mr. Insull remarks on the generally increased cost of all kinds of labor and material, and the unusually large expense to which the company was put, partly in storage of coal and partly because of its increased cost owing to the scarcity resulting from the difficulties of transportation caused by the severe weather of last winter. To guard against the possibility of a shortage of fuel the company took the precaution to have on hand at all times during the year an unusually large supply of coal; consequently the coal miners' strike, extending over a period of five months, did not endanger the continuity of the company's service.

The company's connected business (exclusive of electrical energy supplied to other public-service corporations) amounted to the equivalent of 5,915,622 standard 16-cp lamps on Sept. 30, 1910. The corresponding figure for the year before was 4,920,800, showing a gain during the year of 994,822 16-cp lamp-

equivalents, or 22 per cent. This is exclusive of the "railway" load, which is considerably larger than the commercial load.

During the year the company called for redemption $5,335,000 worth of Chicago Edison bonds and issued $3,117,000 of Commonwealth Edison bonds to replace those already turned in, at the same time depositing with the Northern Trust Company $2,405,000 in bonds to insure the retirement of the outstanding Chicago Edison bonds. During the fiscal year the authorized capital stock was increased from $30,000,000 to $40,000,000, and $2,721,897.50 was paid in at par for new stock during the year. Additional bonds issued and sold during the year amounted to $3,050,000.

Perhaps the most important development of the year was the beginning of work on the new Northwest generating station. Mr. Insull refers to this as follows: "In order to take care of the company's continued increase in business your directors have acquired 112 acres of land on the North Branch of the Chicago River, north of Belmont Avenue, for the purpose of building thereon a central power plant which will have an ultimate capacity of 360,000 hp. Work on the first section of this plant is now in progress and it is expected that 60,000 hp of machinery will be installed and in operation by next autumn."

The report, which is a most satisfactory one, includes the names of the directors and officers of the company, a list of the four generating stations and thirty-six substations and the certificate of Arthur Young & Company to the effect that they have examined the books and accounts of the company and found the figures to be as stated in the report.

Annual Report of Department of Electricity, Chicago.

The annual report of the Department of Electricity of the City of Chicago for the year 1909, somewhat belated, has recently made its appearance. The report shows that there are 427 officers and employees in the department, which has charge under the city electrician of the street lighting of the city, the fire-alarm telegraph and police telegraph systems, the inspection of all electric wiring, and all other electrical matters in which the city is interested. Mr. William Carroll, the city electrician, is at the head of the department.

During the year 1909 the department expended $1,373,891 and earned $177,102, principally in fees for electrical inspections. On Dec. 31, 1909, the city was operating from its municipal stations 12,189 arc lamps and renting 881 arc lamps from the Commonwealth Edison Company. The average number of lamps owned and operated wholly by the city during the year was 11,592 and the average cost of the operation and maintenance of these lamps is said to have been $41.25 per lamp per year. This amount includes all cash expended for labor and material, superintendence and advertising, but does not include interest, depreciation, allowance for taxes, water rates, rents of city electrician's quarters, rental of poles belonging to private companies and used by the city, nor a portion of the cost of the work of other branches of the city government which contribute more or less to the electric lighting service, as the department of finance and the law department, for instance. Mr Carroll notes in his report that these charges, "it is claimed," should be included in the cost of city lighting. The contract price of each of the arc lamps rented from the Commonwealth company is $75 a year.

Of the cost given for each lamp per year, $41.25, it is interesting to note the various component parts. Some of the items are as follows: Sanitary District electrical energy, $12.30; carbons, $2.86; repairs to electric plants, $1.10; repairs to lamps, $2.70; repairs to circuits, conduits and posts, $6.40; lamp trimming, $8.74; station labor, $3.52. These and some smaller items make a total of $40.71, to which 54 cents is added for superintendence and office expense.

Mr. Carroll expresses himself in favor of making the greatest possible use of the electrical energy of the Sanitary District to light the streets, and since his report was written an arrangement to carry this idea into effect has been entered into.

During the year the Bureau of Electrical Inspection issued 28,539 permits, an increase of 6993 compared with the preceding year. Mr. Carroll says that the subject of re-inspections of electrical wiring installations is one of the very greatest importance. An effort is made to perform part of the work of re-inspecting that should be done, and it is hoped that more re-inspections may be made in the future.

The following table shows the number of electric lighting stations and lamps in the City of Chicago under the jurisdiction of the department:

	Stations.	Arc Lamps.	Incandescent Lamps.
Commercial companies, central stations	22	20,519	2,914,348
Isolated plants	897	10,571	531,361
City plants, street lighting	7	11,592	....
City plants, isolated, including water works	13	80	3,215
Totals	939	42,762	3,448,924

The number of electric signs in the city at the end of 1909 was 5231.

The horse-power rating of motors in Chicago supplied with electric energy by central-station companies is given as 159,244

Edison Sault Plant May Be Condemned.

Proceedings are now pending in the United States Circuit Court for the Western District of Michigan for the condemnation of certain property at Sault Ste. Marie, Mich., including the water-power plant of the Edison Sault Electric Company. The property of the Edison company is a part of the property north of the Canal Grant and on the American side of the international boundary. The pending proceedings are taken in pursuance of the river and harbor act of March 3, 1909, by which all the lands and other property north of the present St. Mary's Falls ship canal throughout its entire length lying between the canal and the international boundary are to be acquired by the United States. This property is to be taken by the government for the purpose of facilitating the navigation of the Great Lakes. To this end a new lock and dam are to be built at Sault Ste. Marie and it happens that the property of the Edison Sault Electric Company stands in the way of this improvement; hence the condemnation proceedings.

Hydroelectric Development on the Desplaines River, Ill.

Testimony is being taken by a United States commissioner in Chicago in the suit of the United States government against the Economy Light & Power Company, of Joliet, Ill. The suit was brought a year ago on the claim of the government that the Desplaines River is a navigable stream and that, therefore, the company cannot lawfully construct a dam at Dresden Heights, near the confluence of the Desplaines and Kankakee Rivers, to form the Illinois, as the company started to do in making a new hydroelectric development at that place. The same question had previously come up in the Supreme Court of Illinois, and that tribunal upheld the company, finding that the Desplaines was not a navigable river.

If the river is navigable the permission of the Secretary of War should have been obtained before any obstruction to navigation was made in the river. The contention of the government, notwithstanding the decision in the state court, is that the stream is navigable. A number of witnesses have been heard in the pending proceedings, some of them testifying in relation to records 200 years old relating to the use of the Desplaines by the early explorers. In the meantime the company has discontinued work on the proposed Dresden Heights

development until a decision has been reached. Its main generating station utilizes the water-power of the Desplaines at Joliet.

For its fiscal year ended April 30, 1910, the Economy Light & Power Company reports gross earnings, $406,746; expenses, $217,654; net earnings, $189,092; bond interest, $75,743; balance, $113,349. The capital stock of the company is $3,000,000, and $1,546,000 in bonds has been issued. The total assets are given as $5,039,561 and the surplus stands at $413,075. On April 30, 1910, the connected load was equal to the equivalent of 266,220 16-cp lamps. The officers of the company are: President, Mr. Samuel Insull; vice-president, Mr. Charles H. Randle; treasurer, Mr. Charles A. Munroe; secretary, Mr. John F. Gilchrist.

Canadian Water-Powers.

The total available horse-power of the rivers of Canada is stated to be 25,682,907 on the basis of minimum flow development. Of this total only about 2 per cent (516,887 hp) is now developed. The distribution of the water-powers in the various provinces is as follows, the figures representing horse-power: Yukon, 470,000; British Columbia, 2,065,500; Alberta, 1,144,000; Saskatchewan, 500,000; Manitoba, 504,000; Northwest Territories, 600,000; Ontario, 3,129,168; Quebec, 17,075,939; New Brunswick, 150,000; Nova Scotia, 54,300.

In January there will be submitted to the Dominion Parliament a bill respecting the water-powers of Canada. The objects of the law come under seven heads as follows:

1. Water-powers to be alienated for stated period only. 2. Reference of the application for water-powers is to be made to the Conservation Commission before alienation. 3. Determination of the development to be made, and the right of entry and the annual rental calculated on the horse-power used. 4 Time within which proposed development is to be made, and forfeiture in case of non-observance and revision of rentals at expiry of each period. 5. Indemnification of lessee in case of failure to agree after each period. 6. Control of rates at which the public at large is to be supplied with electric power by the lessee. 7. Jurisdiction to determine differences between the government and lessees in case of failure to agree in some independent tribunal.

Dangers of Gasoline Lighting.

Colorado Springs, Col., has adopted an ordinance directed at the danger incident to gasoline lighting. In order to install a gasoline lighting outfit it is necessary to obtain a municipal permit, the application for which shall contain a description of the machine or system to be installed. It is the duty of the city electrician to determine if the system and apparatus comply with sections of the ordinance which specify in detail the requirements, and thorough inspection is directed with respect to installation and use. Following are the requirements as to allowable systems, their installation and use:

Only such gasoline vapor gas lighting machines and systems as have inside carburetors, outside carburetors and flame-heated generators shall be permitted.

All carburetors, generators or other devices of whatsovere name used for the purpose of vaporizing or gasifying gasoline for use in connection with gasoline vapor gas lighting machines and systems shall, if located inside of the building walls, be inclosed in an extra cabinet constructed of at least No. 14 sheet steel, and all parts of the machine or system containing liquid gasoline shall be inclosed in this cabinet.

All tanks used for the storage of gasoline in connection with gasoline vapor gas lighting machines and systems shall be located outside of the building and if over 6 gal. capacity shall be buried under the ground in an approved manner. All tanks of 6 gal. capacity or less shall be inclosed in a cabinet constructed of at least No. 20 galvanized iron with door securely locked.

All lamps used in connection with gasoline vapor lighting machines and systems shall be rigidly supported at least 2 ft. from the ceiling and shall not be located within 3 ft. of any inflammable goods, shelving or other combustible material.

All gasoline vapor gas lighting systems having inside flame-heated generators shall be equipped with a shut-off valve, securely fastened to the inside of the cabinet inclosing generator.

All valves used in connection with gasoline vapor gas lighting machines and systems shall be constructed of non-corrosive material.

The rules and requirements pertaining to Class A, Class B and Class C of the National Board of Fire Underwriters for the construction, installation and use of gasoline vapor lighting machines and systems are included in the ordinance, and no gasoline vapor gas lighting machine or system will be permitted to be installed which is not listed with them.

Interference with Telephone and Telegraph Lines by Single-Phase Railway Operation.

A decision handed down on Nov. 19 by the Indiana Appellate Court in the case of the Lake Shore & Michigan Southern Railroad Company, the Postal Telegraph-Cable Company and the Western Union Telegraph Company against the Chicago, Lake Shore & South Bend Railway Company is of general interest because it upholds the right of the defendant to operate a single-phase, high-tension alternating-current railway even though there is interference with the successful working of adjacent telephone and telegraph lines by inductive effect.

About two years ago the railroad company and the telegraph companies brought suit against the defendant, which operates a single-phase interurban electric railway between Chicago and South Bend, Ind., with a trolley voltage of 6600. The case was brought in the Superior Court of Laporte County, Ind., and the plaintiffs sought to restrain the defendant from operating its single-phase trolley lines on account of interfering with their telegraph and signal wires owing to excessive inductive effect. The lower court decided against the complainants, and the case was taken to the Appellate Court. Here argument was made at Indianapolis early last summer, and the court has now handed down its decision. In substance the judges refuse the petition of the railroad and telegraph companies and say that the electric railway company has a right to operate its high-voltage single-phase transmission and trolley lines. In delivering its opinion the court says:

"In the absence of any charge or showing of negligence, unskilfulness or malice on the part of the defendant, an interurban railroad cannot be enjoined from using in the operation of its cars on the right-of-way belonging to it an electric system known as the single-phase, alternating-current system and the high-tension current of electricity required to operate cars thereby, even though the use thereof may greatly interfere with the maintenance and use by plaintiff of its electric telegraph lines and signals necessary in the operation of plaintiff's railroad on its property adjoining the defendant's right-of-way. The use of the single-phase alternating current of electricity to effect a lawful purpose on one's own premises does not constitute a nuisance even though the electricity may escape and interfere with the operation of electrical devices on adjoining property. In the absence of negligence any damage caused thereby is *damnum absque injuria.*

"In the absence of any physical injury to plaintiff's property or the actual taking of any of it the mere interference by induction with a use which the plaintiff desired to make of such property caused by the use to which defendant devotes its own property in the operation of its cars by electricity does not constitute a wrong which can be enjoined, even though defendant threatens to extend such use to the degree of entirely destroying the value of plaintiff's telegraph lines.

"As between the two parties, both using electricity, but for different purposes, under public franchises granted by the Legislature, and both conducting business in which the public is concerned, priority of use does not give an exclusive right."

It appears to be the opinion of the court that the railroad and telegraph companies cannot successfully maintain a monopoly of the earth or of the atmosphere. Apparently if their systems of communication are interfered with by reason of induced currents it will be necessary for them to apply such devices and remedies as may be had to overcome the difficulty. Perhaps the case will be appealed to the Supreme Court of the State, although it is said to be a rare thing for the Supreme Court to reverse a decision of the Appellate Court, as the latter in Indiana is practically a part of the Supreme Court. It is reported, however, that the case may be carried to the United States Supreme Court.

Mexican Rubber.

The enormous profits that are being made in the guayule rubber industry in Mexico and the upper border region of Texas are causing European investors to give the matter their attention. Advices have been received here that an English syndicate with a capital of $5,000,000 has purchased the large crude-rubber factory of Adolfo Marx at Saltillo, State of Coahuila, and several smaller guayule manufacturing plants in that part of the country. Mr. Marx is one of the pioneers in the industry. He started in it a few years ago with small capital and has made a fortune which is said to run up into the millions of dollars. Another interesting development will come from the sale of extensive guayule interests of the Maderos to this new English syndicate. Everisto Madero & Sons are, next to the Intercontinental Rubber Company, the largest producers of crude rubber in Mexico from the guayule shrub. They own a number of large factories, scattered over their broad landed estates, and these have an aggregate output nearly equal to that of the Intercontinental Rubber Company, which is a subsidiary of the United States Rubber Company. In addition to their rubber factories the Maderos own more than 4,000,000 acres of the best guayule shrub land in Mexico, and have several other million acres leased at low rental for a long period of years.

The Intercontinental Rubber Company has been negotiating for several months with the Maderos in an effort to purchase their extensive holdings. It was reported last May that the deal was consummated and the consideration announced was $15,000,000 gold. A hitch arose at the last moment and the transaction was declared off. Everisto Madero, the head of the house, is eighty-four years old and it is said that he is anxious to be relieved of the business cares that his enormous holdings impose upon him. The recent action of his grandson, Francisco I. Madero, in joining the revolutionary element of the country is a source of much worry to the senior Madero. It is charged by Francisco I. Madero's father that the federal government has placed an additional heavy burden of taxes upon their property because of the political imbroglio.

The official statement of the national Treasury Department showing that during the fiscal year ended June 30, 1910, the exports of crude rubber and guayule shrub from Mexico aggregated in value $26,228,189 Mexican currency, which is equivalent to $13,114,094 gold, gives some idea of the extent of the new industry. These figures include the rubber-tree product, but as there was so little of this it is hardly worth considering in the total exportations. The production of crude rubber from the guayule shrub is constantly increasing, notwithstanding the recent depression in prices. It is estimated that the exportations from Mexico of this product and the shrub for the current fiscal year will be upward of $20,000,000 gold. Last fiscal year the value of the shrub that was exported to factories in the United States and Europe for treatment was $9,468,121.

The total value of all exports from Mexico for the fiscal year ended June 30, 1910, was $260,056,228 Mexican currency. The guayule rubber and shrub exportations had an aggregate value of a little more than 10 per cent of the total exportations of the country. This is a remarkable showing when the fact is considered that the industry was unknown in the commercial world ten years ago.

Refuse Destructor Plants.

Mr. Étienne de Fodor, general manger of the Budapest General Electric Company, recently delivered a lecture before the Municipal Council and the Hungarian Society of Engineers upon the generation of electricity from refuse destruction. The various English and foreign systems of refuse destruction plants were explained and illustrated by means of 150 colored lantern slides, and figures and tables given showed the advantages that a modern destructor plant offers in connection with central stations.

The following table gives data as to the fuel value of refuse in some of the cities which Mr. de Fodor cited in connection with steam generators. The figures represent the evaporation in pounds per pound of refuse:

Gloucester	2.02
Rathmines, Dublin	1.78
Fulham	1.53
Hackney	1.41
Barmen	1.30
Mainz	1.30
St. Petersburg	1.16
Fiume	1.03
Kiel	1.05
Frankfort	1.00
Copenhagen	0.92
Hanover	0.91
Amsterdam	0.90
Christiania	0.89

As a general average one may assume 1 lb. of refuse to evaporate 1 lb. of water, while some plants have been able to produce 50 kw-hours of electricity from 1 ton of refuse.

The lecture included descriptions of the interesting plants constructed by Heenan & Froude, the well-known English constructors of refuse destructors, among which are those erected in London, Glasgow, Gloucester, etc. Interesting features were also brought out concerning plants in operation in Munich, Frankfort, Kiel, Brussels, Wiesbaden, Brünn, Vienna, etc.

Mr. de Fodor has been studying the question of refuse destruction for some years, gathering actual facts and results obtained from nearly all modern and up-to-date destruction plants, as the City of Budapest is contemplating the erection of a modern plant in place of the primitive one that it now possesses. In the present plant nothing is destroyed, but the refuse is picked over and assorted and the rags, bones and other things found are neither disinfected nor sterilized, but are baled or bundled up and freighted away in railroad cars that also carry the usual goods of commerce. In this plant, moreover, myriads of flies and other insects have found a happy Eldorado and the offensive odors are an affliction to the surrounding cottagers. The question of refuse destruction has become acute lately in Budapest, and Mr. de Fodor's lecture was received with great applause.

Resistor for Incandescent Lamps or Heating Units.

A patent was granted Nov. 22 to Prof. Herschel C. Parker and Walter G. Clark on a filament or resistor for heating units or lamps, the date of the application being May 20, 1909. The resistor is in filament form, composed of a solution of carbon in carborundum in which the ratio of carbon and silicon is always greater than one atom of carbon to one atom of silicon. To produce the resistor a mixture of approximately 2 per cent of olefiant gas and 98 per cent of hydrogen is passed through a proper vaporizer containing silicon tetrachloride and into a flashing jar containing a carbon filament through which an

electric current is passing; the current through the filament causes the decomposition of the gases and the deposition of SiC_2 on the heated filament. The resistor filament thus made is, when cold, a conductor of electricity throughout its mass and will glow continuously at incandescence in the open air upon the passage of an electric current through it and maintain continuously in the open air a temperature of about 1500 deg. C.

Welsbach Osmium Lamp Patents.

Four patents were issued Nov. 22 to Carl Auer von Welsbach, of Vienna, relating to the manufacture of the osmium metallic-filament lamp, the application for each of the patents having been filed Aug. 9, 1898. The first patent in order of number relates generally to the manufacture of the osmium filament. It is stated that while osmium was known to be a good conductor of electricity it was not known that it was non-volatilizable when in vacuo or in certain reducing gases at temperatures at which platinum volatilizes, which discovery is utilized as one of the bases of the invention. In making an osmium filament a stiff uniform paste is prepared of osmium or suitable salts, including a binding material, which, under the influence of heat, will resolve itself practically into carbon. The threads made from this paste, after drying, are subjected to dry or destructive distillation, during which the volatile constituents are driven off, so that the filament then comprises a mixture of carbon and osmium. The carbon is then removed by subjecting the incomplete filament to the influence of a moderate heat obtained by an electric current in an atmosphere of gases capable of taking up or removing the carbon without oxidizing the osmium. The osmium particles are partially fused or cemented together by then continuing the current to the development of a heat at which platinum would volatilize. The filaments thus produced are free from carbon, extremely dense and coherent, have the necessary flexibility and elasticity and depend upon osmium not only for their conductivity but for the incandescence which is produced at the temperature at which platinum would be melted. Twelve of the fifteen claims of the patent relate specifically to the use of osmium in producing a metallic filament. The remaining three claims refer to the production of filaments for incandescent lamps, consisting in forming a thread-like body from a paste containing a refractory metal and an agglutinating material, eliminating the latter in a protecting environment, thereby leaving a corresponding thread-like body of particles and progressively consolidating and uniting said particles into a compact, coherent, elastic final filament by the passage therethrough of an electric current at a heat finally reaching a dazzling incandescence. The other two general claims are variants of that just noticed.

The second patent relates to a method in which an inner carrier or fillet is used upon which osmium is deposited, after which the fillet is removed by the heat of an electric current in the presence of suitable gases. Three of the five claims refer specifically to osmium. Of two general claims, one is on associating an organic thread with a metal having a point of fusion higher than that of platinum, subjecting the same to dry distillation, placing it in a suitable atmosphere wherein the carbon is eliminated, and, by the action of an electric current at a temperature at which platinum is volatilized, uniting the metallic particles into a dense, compact, coherent filament suitable for electric incandescence. The second general claim is on a dense, coherent, metallic film for incandescent electric lamps, consisting of metallic particles fritted together and which incandesce at a temperature above that at which platinum volatilizes.

The third patent relates to a means for attaching the filament to the leading-in wires. Four of the nine claims are general in character and refer to an incandescent electric lamp having a metallic filament connected to its leading-in wires by a body or bodies, the metallic base of which is substantially the same as the metallic base of the filament, which latter has an incandescing temperature beyond that at which the metal of the leading-in wires would fuse; a connecting metallic fuse joint uniting the filament and leading-in wires, the metal of the fuse joint being substantially the same as the metal of the filament; a mounting whose fusing point is sufficient to withstand the temperature of the filament and protect the metal of the leading-in wires from fusing or alloying with the filament; the passage of a welding current through the leading-in wires, mounting and filament, thereby completing the joint, the mounting of which is such as to increase the cross-section of the ends of the filament, thereby reducing the resistance, and consequently the temperature at the point of contact of the leading-in wires with the connecting medium.

The fourth patent relates to the use of a platinum wire upon which to deposit fumes or vapors from a volatile osmium compound, after which the platinum core is volatilized by the action of an electric current. Of eight claims of this patent two are general in character, one covering an incandescent filament formed of metal infusible at the temperature at which platinum volatilizes and arranged in a plurality of superimposed minute layers or laminas all rendered compact and coherent. The other is on a process of forming incandescent filaments consisting in depositing intermittently upon a fillet a series of layers of metal infusible at the temperature at which platinum volatilizes and uniting the several layers into a compact and coherent, flexible, elastic filament by raising it above the said temperature.

Recent Progress in Electrical Science.

Dr. R. A. Millikan, professor of physics at the University of Chicago, was the speaker at the luncheon of the Electric Club of Chicago on Nov. 23. His subject was "Recent Electrical Discoveries." Professor Millikan began by saying that he felt that there ought to be a larger understanding between the two main groups of workers who are largely responsible for the progress of mankind. These two groups consist of the men working on fundamentals and the men working on applications. Men engaged in pure research and commercial men are inclined to look askance at one another. Nevertheless the two fields of study are almost identical, and there is continual interchanging and overlapping between the two fields. Practically there is no difference in the problems considered and methods of solving them except that the commercial men stop when they see that the work they are engaged in is not going to pay dividends. But who can tell when and where the work of the pure scientist will result in commercial applications? Modern science began in astronomical studies apparently as purely academic as anything could be; but the work of Copernicus and Galileo started a chain of ideas that made the work of Newton and all successors possible. Any fundamental principle, as in electricity for instance, was at one time an academic problem.

In the last twenty-five years the contributions to electrical progress from the academic side may be classified, perhaps, under four headings:

(1) The discovery of the existence of electromagnetic waves by Hertz. This has had a very practical application in "wireless," but it was the direct result of Maxwell's mathematical philosophizing, which was purely academic.

(2) The discovery of X-rays and radio-activity. This discovery has had a limited practical application, but it gives a suggestion, for it is now known that there are enormous stores of energy locked up in this world if they could only be made available.

(3) The discovery that matter and electricity are in some way allied. What we call mass or inertia may be of electrical origin. The conjecture is a most interesting one, but it is purely a speculation to assume that electricity and matter may be identical. As a matter of fact we do not know any more about matter than we do about electricity.

(4) The discovery of the atomic structure of electricity. This was not the result of any one man's work. Professor Millikan said that the neutral molecules of the air are continuously being broken up into charged particles called "ions." These ions again unite, and in ordinary air this process of disassociation and association is being carried on all the time.

Dwelling on the fourth discovery mentioned, the speaker described his recent interesting experiments at the University of Chicago in which droplets of oil between the plates of an electrical condenser are subjected to the action of an electrical field of a strength between 1000 and 10,000 volts. The plates are 20 cm in diameter and are 16 mm apart, and there is a pinhole in the upper plate. If the droplet receives a charge of the proper sign and strength, as it is blown out through the atomizer, it is pulled up by the electrical field, against gravity, toward the upper plate. Before the droplet strikes this plate the field is thrown off, the plates are short-circuited and the time required by the drop to fall under gravity the distance corresponding to the space between the cross hairs of an observing telescope is accurately determined. Then the rate at which the droplet moves up under the influence of the field is measured. This operation is repeated a number of times, or until the droplet catches an ion from among those which exist normally in air, or which may have been produced in the space between the plates by an ionizing agent like radium. When an ion is caught there is a change in the speed of the droplet under the influence of the field. From the sign and magnitude of this change in speed, taken in connection with the constant speed under gravity, the sign and exact value of the charge carried by the captured ion are determined. It is absolutely demonstrated that electric charge gets on the droplet in always the same amount.

These experiments show that electricity has a granular structure. Other experiments with the same apparatus also confirm the kinetic theory of molecular agitation. A subject which will soon be taken up is the question of valency in ionization.

In the discussion Mr. F. B. Badt said that the researches of the speaker would seem to contradict the theories of at least the older text-books, instancing particularly the earlier writings of S. P. Thompson. Professor Millikan was quick to explain that he did not understand that his work conflicted with the conclusions of Dr. Thompson. Professor Freeman, of Armour Institute, said that the researches of Professor Millikan were to be commended in the highest terms. He also emphasized the needs of two kinds of men in electrical research—the workers on the theoretical side and those who are engaged in practical applications. Others who spoke briefly were Messrs. K. B. Miller, E. N. Lake, George P. Nichols and A. A. Gray.

Surging of Synchronous Machines.

At a meeting of the Electrical Section of the Western Society of Engineers at Chicago Wednesday evening, Nov. 23, Dr. Ernest J. Berg, professor of electrical engineering at the University of Illinois, read a paper on the "Surging of Synchronous Machines" which was similar in title and contents to his recent discussion of the same subject before the Rock Island convention of the Illinois Electrical Association. After explaining the causes which lead to the exchange of current between paralleled alternators, causing them to hunt, Dr. Berg gave an enumeration of the electrical remedies which may be applied to correct the trouble where the defect cannot be traced back, as in the majority of cases, to the prime mover or its governor mechanism. These alternatives are:

1. Reducing the resistance of the leads between machines.
2. Excluding external reactances and installing field-damping devices on machines of quick magnetic circuit, especially if synchronous impedance is great.
3. Adding extra reactance in high-speed machines having good mutual induction between field and armature and sluggish magnetic circuits.
4. Changing the natural period of the air-gap or by adding a flywheel.

In closing Dr. Berg remarked that he had never met with a case of surging or hunting, however troublesome, which could not be solved by one of the remedies above suggested.

Following the presentation of Dr. Berg's address several Chicago electrical engineers recounted their own difficulties in paralleling alternating-current machines early in the history of the art. Messrs. James Lyman, Peter Junkersfeld, D. W. Roper and W. B. Jackson took part in this recital of the troubles accompanying the first introduction of each successive type of alternating-current apparatus, but all agreed in saying that they had met with no case in their individual experiences where the hunting was not cured when proper study was made and the indicated remedy applied. Messrs. J. L. Hecht, G. W. Cravens, Dudley, Bardlee and Seymour also spoke briefly on the points brought up in the paper.

American Physical Society at Chicago.

The program of the Thanksgiving meeting of the American Physical Society, held at the Ryerson Physical Laboratory of the University of Chicago, Nov. 26, comprised twenty-six ten-minute talks briefly describing results of recent work and experiments of members. A number of the subjects discussed were of electrical interest.

Mr. F. C. Brown, of the State University of Iowa, gave an account of his recent study of light-negative silenium and proposed an explanation for the remarkable resistance changes of this material, which are the reverse of those usually noted with high-sensibility silenium. The sensibility of light-positive silenium is a function of its resistance. A certain specimen having a resistivity of 1,000,000,000 ohms changed its resistance in the ratio of 300 to 1 when exposed to intense illumination, while a Giltay cell having a resistivity of 500,000 ohms showed a sensibility of 30 to 1. But the light-negative silenium has a resistivity of only about 100 ohms and displays its resistance changes in the opposite direction. Mr. Brown also showed that its resistance changes due to temperature and moisture are the reverse of those met in high-sensibility silenium. The light-negative silenium is very unstable, a slight jar or quick temperature change causing it to go into another light-positive form; but when put away in the dark for two months one specimen returned to its original condition. The speaker offered, as a hypothesis for the light action of silenium, the explanation that the element as prepared for photo-sensitive cells is made up of three kinds of allotropic modifications, *A*, *B* and *C*, one of which is a small or zero conductivity, and the other two of lower resistivity, the three forms passing back and forth into each other with changes of light intensity. Mr. Brown also experimented with the results of electrical and mechanical pressure on silenium.

Mr. A. W. Smith, of Ohio State University, reported his experiments with the antimony alloys of bismuth, cadmium and zinc, which he investigated for resistivity, temperature coefficient of resistivity, thermo e.m.f., change of resistance in magnetic fields and the Hall, Nernst and Peltier effects, many of which phenomena showed striking changes in value of the alloy ratios where crystallization and chemical combination take place.

Mr. Robert F. Earhart, of Ohio State University, discussed experiments for measuring the energy necessary to maintain electric discharges through gases, which he found to be independent of the temperature, below a temperature of 1000 deg. for hydrogen, air and carbon dioxide, the gases studied.

Mr. Gordon S. Fulcher presented evidence to show that the "canal" rays of the vacuum tube produce light by molecular collision, the molecule struck setting up the ether vibrations and the light intensity produced being proportional to the number of collisions. However, no light is developed unless sufficient energy is present to cause ionization. Prof. R. A. Millikan, of the University of Chicago, discussed the increase in positive potentials of metals exposed to ultra-violet light, showing that the photo-electric potential produced is proportional

to light intensity. Mr. J. R. Wright, also of Chicago, referred to the relation between electrification and luminous frequency and reported on the potentials reached by exposing an electrode to intermittent zinc sparks, rich in the ultra-violet wave length.

Mr. W. F. Lent, of the University of Wisconsin, presented a method in conjunction with Prof. C. F. Mendenhall for measuring magnetic susceptibility from which highly accurate results have been obtained. Mr. E. H. Williams, of the University of Illinois, reported some experiments with transverse planed joints in magnetic circuits, showing that while in the case of iron the magnetic resistance was increased above that of the unbroken section in nickel, under certain conditions it might be decreased.

Mr. C. Nusbaum, of Ohio State University, exhibited some diagrams prepared with a potentiometer and curve tracer, recording the first and the successive anode and cathode flows through an aluminum-magnesium and carbon rectifier cell. Critical values were pointed out, at one of which the primary discharge occurs at a higher potential than those following, while at another point the reverse is observed. Mr. Nusbaum had also experimented with varying ratios of aluminum and magnesium in his electrode plates.

Mr. W. E. Forsythe, of the University of Wisconsin, showed curves of luminous efficiency of tungsten, tantalum and carbon lamps. In these tests the tungsten lamp showed an absolute or luminous conversion efficiency of 4.5 per cent at 2300 deg., the carbon-lamp curve extended showing that the carbon lamp would have even a higher efficiency at this temperature. Mr. George O. Weimer, of the Ohio State University, reported the break-down results of tests on porcelain insulators at high temperatures, in which a 250,000-volt, 150-kw transformer and an electric furnace and oil bath were used. After a temperature of 500 deg. is reached he found that porcelain ceases to be an insulator and apparently becomes an electrolytic conductor.

Mr. F. W. Pote, with Mr. Earhart, of Ohio State University, had investigated the total current and distribution of a discharge between a plane and a point, using concentric insulated rings of brass for the plane surface and a platinum point. The experiments were made under pressures from 0.4 mm to 10.0 mm of mercury, and showed that the quantities investigated were functions of the distance, voltage, gas pressure and polarity of the point, although the distribution of discharge may not vary with the intervening gas, as does the current.

Massachusetts Commission News.

The joint board consisting of the Massachusetts Railroad and the Boston Transit Commissions has recently been studying the problem of extending the Cambridge subway from its forthcoming Boston terminus at Park Street to the South Station, South Boston, and Andrew Square, Dorchester. The joint commission will present a report to the next Legislature with special reference to the extension of this subway under Winter and Summer Streets to the South Station, including elaborate engineering studies of the cost and best methods of doing the work.

The Massachusetts Gas & Electric Light Commission has issued a decision modifying the prices charged for gas and electricity by the Newburyport Gas & Electric Company in the petition of the Mayor of the city to the board. The decision is of special interest on account of the variety of questions with which it deals, practically every branch of the company's service being taken into consideration. The petitioners desired reductions in the prices charged for street and commercial lighting, gas lighting, and in connection with motor-service rates the issue of discrimination was raised. The company has supplied gas and electricity in Newburyport since 1889, the net price for gas being $1.40 per 1000 cu. ft. The existing prices for electricity are: For commercial lighting, 20 cents per kw-hour, with a discount of 25 per cent for prompt payment; for motor service, 10 cents, with discounts from 5 per cent to 65 per cent, varying according to the monthly bill, and for street lighting operated upon a moonlight schedule to 1:15 a. m., $73.50 per arc lamp and $30 per incandescent lamp per year.

The decision discusses the question of discounts as follows: "In accordance with the practice common throughout the State, it is the custom of this company to make a discount from its gross rate to a net price for prompt payment of its monthly bills. The purpose and only justification for this practice is that it enables the company to make prompt collection of its accounts and to conduct its affairs with greater economy and efficiency. It appears, however, that the difference between the gross and net prices for electricity is much greater relatively than in the prices for gas. Since in the latter case the difference made has proved ample to accomplish the main purpose of the arrangement, the company may well afford to lessen the amount of its electric discount by a lowering of the gross price charged."

Regarding the charges of discrimination, the board states that "in the present development of the electrical business, especially in cities the size of Newburyport, it seems unlikely that electricity can be sold for lighting at prices which will be attractive to those who desire to use it for motor service, and the prices which the public are willing to pay for the latter use seem to be largely determined by the cost of other available forms of power. This company has a very considerable investment, made primarily for the purpose of supplying the community with light. If employed for this purpose alone the daily use of the investment would be brief and the cost per unit of electricity sold correspondingly high, but the sale of electricity for motors almost invariably increases the volume of output without necessarily increasing the investment, thereby reducing the average cost per unit sold and thereby making possible a lower maximum price. Because of such considerations and because such increased efficiency in the use of the investment should lead to reductions in the maximum net price, the board has been reluctant to interfere with certain differentials in price, especially those applying to motor service. In this course it has sought rather to benefit the many who must pay the maximum price than the few in whose interest differentials are apparently made. These propositions indicate that the maximum net price for electricity cannot be determined solely with reference to the average cost per unit of all the electricity which a company may supply. During the last fiscal year the company's output for motor service exceeded its output for lighting; its motor load was nearly one-half its yearly peak, and it received for this energy scarcely more per unit than the bare cost of producing the electricity itself without any substantial provision for expenses of distribution, management, taxes or investment return."

The commission finds that discrimination exists between two of the motor users in the same line of business. It points out that there may have been some justification for making a special contract some years ago when the company was trying to introduce the use of energy for motors by means of a flat rate, but condemns the renewal of the contract in 1909. The company had refused to quote the same rates to a rival customer. The board finds that the special contract should be discontinued if, and as soon as, the company can relieve itself of the obligation. It also appears that the company is making a special rate to motor customers with installations of 100 hp and over. The board recommends that such rates be included in the published schedules of the company. In conclusion, the board recommends that the offer of the company to supply street lighting on a five-year contract basis be applied on a yearly basis as well. The company is now supplying 173 inclosed arc lamps of nominal 1200 cp and twenty-four incandescent lamps of 32 cp used on an average twenty-six nights per month and six hours per night. Save for some increase in number, the equipment appears to be the same as when the present management came into control of the company. The company made a price for these arc lamps for all night and every night of $95 each on a one-year contract, $92 on a three-year contract and $90 on a five-year contract, and the petitioner requested the board to make a reduction in this price. There

was no offer of any change in equipment or service in the consideration of a contract longer than one year and no reason other than length of time shown for a difference in price. The board says that "while the price at which the company voluntarily offers to furnish these arc lamps is not conclusive as against the city that such price is reasonable, it may properly have its effect as against the company * * *," and having in view the fact that no new equipment is offered or required, the board is of the opinion that the prices hereinafter named are reasonable and fair for all-night and every-night service for the type and rating of the lamps now installed, even though a contract for the same is made for one year only. The board recommends that on and after Jan. 1, 1911, the net price for gas shall not exceed $1.35 per 1000 cu. ft., and that the net price charged for electricity shall not exceed 14 cents per kw-hour with such minimum monthly charges to its lighting customers as it now employs, but not exceeding $1 per month, and that the price for street lamps used all night and every night shall not exceed $90 per arc lamp or $30 per incandescent lamp per year.

The Railroad Commission recently sent an inquiry to all transportation companies operating electric cars asking what progress, if any, has been made in the installation of devices by which arc headlight rays can be confined more closely to the track. Practically all the replies received, which include the larger as well as many small companies, state that no practicable apparatus for this purpose appears as yet to have been developed.

Canadian Hydroelectric Commission News.

The London Electric Light Company has appealed to the Hydroelectric Commission to prevent the city corporation of London lowering rates for Niagara energy to such an extent that there will be a deficit. Mayor Beattie has advocated an increase in the discount rate from 10 per cent to 25 per cent, in order to undersell the London Electric Company and put it out of business, and this action on the part of the Mayor was made the basis of an appeal by the company to the commission.

The light committee of Berlin, Ont., the first city to receive Niagara energy from the Hydroelectric Commission, has fixed the rates for residential lighting. There will be a fixed rate or charge per 100 sq. ft. of the area lighted of 5 cents per month, and, in addition, a charge per kw-hour of 4 cents. The bills are subject to a discount of 10 per cent if paid within a month, and a further discount if paid within ten days after receipt.

A flat rate for residences of $6 per month for all purposes was decided upon. The rate for service to the factories has not yet been named. It is expected that during the third week in November a continuous twenty-four-hour power service will be furnished from Niagara Falls.

The town of Mitchell has voted in favor of utilizing power from the commission. Nine thousand dollars worth of debentures will be issued to provide the funds for purchasing the necessary equipment. The power is expected to be ready in February.

It has been announced that Niagara power will be available for use in Toronto about Dec. 15.

Wisconsin Commission News.

The commission has taken testimony in the matter of the application of the Kenosha Electric Railway Company for a certificate of convenience and necessity. The Kenosha Gas & Electric Company is doing business in Kenosha at the present time and this is the first case where a competing company has applied to the commission for a certificate. The applicant is now doing a street railway business exclusively, but claims that the evidence in the case introduced by both the municipality and the petitioning company shows that in general the existing conditions make it a public necessity that the Kenosha Railway Company be permitted to conduct a regular electric lighting and power business in the City of Kenosha and that it is apparent from the testimony that not only is the service rendered by the present company poor and inadequate, but that little effort has been made or is now being made to improve and extend the business. The major part of the territory is very poorly covered in comparison with other cities under similar circumstances.

In the Supreme Court case of the Kenosha Electric Railway Company now pending the constitutionality of the Public Utility Law has been attacked. The company's attorneys charge that the right of the commission to decide whether a new public utility can be started in any city where there is one at present is unconstitutional because it involves a legislative function. The State argues that the function is administrative.

Commissioner Roemer, sitting for the commission, has taken testimony at La Crosse in the matter of the application of the La Crosse Gas & Electric Company for an increase in rates. The bulk of the testimony concerned the valuation of the property for rate-making purposes.

The present company was formed through the consolidation of four competing companies whose stockholders were in the main the same. The stock and bond issues of the past, which were assumed by the present company in the consolidation, are in excess of the physical valuation. The company now has three plants and a considerable duplication of machinery, buildings and transmission systems. The city objected to the company's claim that it should be allowed to earn interest upon machinery and property not actually necessary for the use of the public. Furthermore, the respondent company in arriving at its contended valuation resorted to the method advocated by the commission in its decision of the Madison Gas & Electric Company, in which the failure to earn a given fair percentage was considered year by year in arriving at an equitable present value. This method makes allowances for the cost of building up a business. The city objects to the use of this method in the present case because during the times immediately preceding the several consolidations when the present parent company was trying to force the newer company out of business by cutting the rates energy was sold at less than cost, and these losses would be capitalized. Further testimony will be taken at a later date. The city was represented by J. F. Doherty. Woodard & Lees appeared for the company.

The commission has approved the application of the Monroe Electric Company for authority to issue $1,200 of stock of par value $100 per share and $4,000 par value of bonds in denomination of $500 each. The funds to be derived from the sale are to be used in paying outstanding indebtedness incurred by additions and extensions to the plant.

The commission has handed down a decision in the case of the Woodmont Country Club vs. the Milwaukee Electric Railway & Light Company. The petitioner is a social organization and maintains a club house and golf grounds in the town of New Berlin, Waukesha County, near a line of the respondent, such line being the only means of transportation to and from the grounds. It appeared that during the season about 5000 people visit the grounds and that the station of the respondent nearest the club house is distant about 4180 ft. over a road constructed by the petitioner. The petitioners prayed that cars be ordered stopped at a point near the grounds. The respondent objected to stopping cars at the proposed point for the reason that the grade at such point is heavy and also that the policy of the respondent is to establish stations only at highway crossings and about one mile apart. The commission did not think that the former objection was tenable, for the grade at the point in question is only 1.2. It also commended the policy of the company in limiting the number of stations on its line and stated that it ought not to be interfered with except for good causes. But this case was regarded as an exceptional one, inasmuch as at no other station excepting the municipalities were so many people served as at County Line station, the station now used by the Country Club.

The commission finds that the service rendered by the respondent in the particular complained of is inadequate and that to render the same reasonably adequate it will be necessary for the respondent to stop its cars at the proposed point. It was so ordered, provided the petitioner first obtains a concession from the Northwestern Railway Company to cross its right-of-way and construct a subway so that persons will not be obliged to cross the steam railroad tracks at grade.

New Jersey Commission News.

The Board of Public Utility Commissioners for the State of New Jersey approved the petition of the Public Service Gas Company for the proposed issuance of $500,000 of its capital stock. The petitioner recited that it is a corporation organized and existing under the laws of the State of New Jersey; that its authorized capital stock is $10,000,000; that at the date of the petition there are issued, sold and outstanding $6,000,000 par value; that the issue of $500,000, of which approval is asked, is to be sold for cash at par, the proceeds to be used for extensions and betterments of plant. In its certificate of approval the board expressed itself as satisfied that the issuance sale and delivery of the stock for cash at par is to be made in accordance with the provisions of law relating thereto. The board requests that the company file with it semi-annually a statement setting forth the amount of capital stock issued, sold and delivered under the certificate of approval and the extent to and purposes for which the proceeds thereof have been disbursed.

The board has also approved the application of the Newark & Bloomfield Railroad Company for a proposed issuance of 29,923 shares of its capital stock for cash at not less than its par value. The board notes that the error in the application previously made, approval of which application was withheld, has been corrected; that a copy of the certificate has been laid before the board, showing that the increase of capital stock was formally assented to in writing by the stockholders and that copies of resolutions have also been filed providing that the holders of authorized capital stock of the company now outstanding be permitted to subscribe for the proposed issue in proportion to their respective holdings. The board in approving the application has made a request similar to that made of the Public Service Gas Company as noted above, that the company file with it semi-annually a statement setting forth the amount of capital stock issued, sold and delivered under the certificate and the extent to and purposes for which the proceeds thereof have been disbursed.

Maryland Commission News.

It is claimed that the United Railway & Electric Company, of Baltimore, violated its provisions when it summarily discontinued sale of the 7½-cent commutation books to its patrons living in the suburbs just outside of the 5-cent fare zone. Mr. Victor J. Bloede, who is prominently allied with the Patapsco Electric Light & Power Company, and who secured the 7½-cent rate for the Catonville residents about seven years ago, called a meeting of the residents last week, and as a result a case will be presented to the commission for its consideration in the near future. As the result of a meeting of the United Improvement Association of Woodlawn, a committee has been appointed to wait on the officers of the United Railways & Electric Company and urge the restoration of commuters' books and the establishment of some other schedule of car service than now exists between Woodlawn and city points.

Mr. James M. Ambler, chairman of the Maryland Public Service Commission, states that in the order passed by the commission relative to the reduced fares on certain routes of the United Railways Company it was pointed out that the sale of such tickets to some patrons of the road and not to all patrons was discrimination in favor of a certain class of passengers. Discrimination is forbidden by the law. The United company, however, discontinued the sale of residents' tickets, though it could have made such sale general and complied with the law. It has been previously stated by members of the commission that while the Public Service law permits them to sanction the sale of commutation and excursion tickets, it does not permit them to require public-service corporations to sell such tickets.

In the face of the rulings of the commission on the points involved it would seem that those making the protests would find difficulty in establishing their claims. It has been suggested, however, that the hearing will result in opening up the whole question of street-railway fares. While the commission may not be able, under the law, to order the continuation of the sale of residents' tickets, it can, it is said, exercise its powers in regulating the width of the company's fare zones and fixing the fares to be collected over them, giving everyone an equal privilege. Dec. 13 has been set by the Public Service Commission as a time limit during which the United Railways may answer the complaints of the various civic leagues which have filed their protests with the commission. If the company fails to answer satisfactorily the commission will then set a date for a public hearing.

New York Commission News.

All of the members of the Public Service Commission, Second District, will be in New York this week to take up various complaints in that city claiming that the interborough toll rates charged by the New York Telephone Company are excessive and unreasonable and that in many cases there are discriminations in charges and practices. The hearings will be held at the rooms of the Engineering Societies' Building, 29 West Thirty-ninth Street. Complaints generally are against the 10-cent charge between boroughs in the greater city and the commission is asked to reduce the charge to 5 cents for each message.

Among the complainants, all of whom it is expected will be represented at the hearings, are the Board of Aldermen of the City of New York, Prospect Park South Association of Brooklyn, the Flushing Association, the Ditmars Park Association, Jamaica Citizens' Association, New York Board of Trade and Transportation, Flatbush Taxpayers' Association, Down-Town Interborough Association, South Midwood Association of Brooklyn, Brooklyn Board of Real Estate Brokers, W. L. Perrin & Son, Paul E. Lindbald & Company and Charles H. Davids, of the Bronx.

AMERICAN ELECTRICAL ENGINEERS.

R. F. Schuchardt.

Rudolph Frederick Schuchardt was born Dec. 14, 1875, in Milwaukee, Wis., where he received his primary and secondary education in private and public schools. In 1893 he entered the electrical engineering course of the University of Wisconsin, from which he was graduated four years later. In order to gain practical experience, college vacations were spent in the shops of the E. P. Allis Company at Milwaukee.

Upon graduation Mr. Schuchardt entered the central station at Janesville, Wis., but soon after went to Chicago, joining the staff of F. B. Badt & Company, consulting engineers and manufacturers' representatives. In June, 1898, he entered the employ of the Chicago Edison Company as night operator in the new storage-battery substation on Adams Street, and shortly after was sent to Omaha to take charge of the company's exhibit at the Trans-Mississippi Exposition.

Upon his return to Chicago at the close of the exposition Mr. Schuchardt entered the statistical department of his company, and a year later was transferred to the testing laboratory. When in 1903 the pioneer 5000-kw turbo-generators in the Fisk Street station of the company were started, he was assigned to take charge of the electrical operating force there. In

order to assist in making correct connections in the construction work he devised and patented a phase rotation indicator which has since been found a valuable help and time-saver in construction work, as well as on the distribution system. Mr. Schuchardt was in charge of engineering testing in 1905 and 1906, and in November of the latter year he became engineer of electrical construction. In July, 1909, he was appointed electrical engineer of the company, succeeding Mr. P. Junkersfeld, who was appointed assistant to the second vice-president.

In the past twenty-two years' history of the Commonwealth Edison Company and its predecessors, Mr. Schuchardt is the third man to receive the appointment of electrical engineer, the first being Mr. Louis A. Ferguson, now second vice-president. Mr. Schuchardt as electrical engineer is in charge of the engineering department, the most important work of which at this writing is the design of all electrical features of the new Northwest Station, comprising six 20,000-kw turbo-generators and the necessary extensions of the company's transmission and substation system.

Mr. Schuchardt has contributed a number of papers to the *Transactions* of engineering and central-station societies and

R. F. Schuchardt.

to the technical press, beginning with a paper on "Electricity Meters of To-day," read at the 1897 convention of the Northwestern Electrical Association. A notable article on "Transformer Testing" appeared in these columns in the issue of May 17, 1902, the data of which were later used in Prof. F. G. Baum's work on "Transformers." Among other papers are one on "The Rotary Converter Substation," read before the Western Society of Engineers in 1907, and another on "The Protection of High-Tension Transmission Systems," read before the Chicago branch of the A. I. E. E. in 1908.

Mr. Schuchardt was a contributing editor of the "Cyclopedia of Engineering" of the American School of Correspondence (1904) and was the first editor of the *Edison Round Table*, now in its third year, a monthly publication of the Commonwealth Edison Company. He served as president of the Chicago Electrical Association in 1901, and was one of the engineering experts in the notable street-lighting arbitration case at Colorado Springs in 1907.

Mr. Schuchardt is a member of the American Institute of Electrical Engineers, the Illuminating Engineering Society and the Western Society of Engineers; also of the University Club of Chicago and of the City Club, being a member of the committee on traffic and transportation of the latter.

CURRENT NEWS AND NOTES.

Naval Wireless.—Mr. Julius Martin, naval expert electrical aid at the Brooklyn Navy Yard, will read a paper before the Wireless Institute, New York, on Wednesday evening, Dec. 7, on "Sidelights on the Navy Department Wireless Telegraph Specifications."

Isolated Plants in Chicago.—According to the annual report of the Department of Electricity of the City of Chicago there were 897 isolated plants in that city on Dec. 31, 1909, having an aggregate capacity of 10,571 arc and 531,361 incandescent lamps. The corresponding figures for commercial companies were 20,519 arc and 2,914,348 incandescent lamps.

Display Street Lighting in New York.—The Harlem Board of Commerce has appointed a lighting committee, of which Mr. William J. Meara is chairman, for the purpose of improving the illumination of 125th Street, New York City. A demonstration is being made of flaming-arc lamps placed in pairs about 100 ft. apart between Fifth and Madison Avenues.

Pennsylvania Electric Trains Under Hudson.—Since Sunday, Nov. 27, all through passenger trains of the Pennsylvania Railroad have arrived at and departed from the new station in the heart of New York City instead of the old ferry terminal at Jersey City, N. J. Electric locomotives of the 600-volt, direct-current type haul the trains 8.6 miles between the station through tunnels under the Hudson River and the steam locomotive terminal at Harrison, N. J. The service was inaugurated without a hitch, the electrical equipment operating with thoroughly satisfactory results.

Ohio Engineers.—The Ohio Society of Mechanical, Electrical and Steam Engineers has chosen the following officers: President, Mr. Oscar S. Rabbe, of Toledo, re-elected; vice-president, Mr. H. L. Patterson, of Youngstown, succeeding Mr. W. C. McCracken, of Columbus, whose term expired; manager, Mr. John J. Hoppes, of Springfield, succeeding Mr. W. E. Haswell, of Columbus; manager, Mr. Daniel Delaney, of Cincinnati, succeeding Mr. L. G. Kaiser, of Cincinnati. The next convention will be held at Youngstown, May 18 and 19, 1911.

Liability of Telegraph Company.—Because the Western Union Telegraph Company failed to transmit a message from Detroit, Mich., to Kansas City, Mo., after accepting it, the Supreme Court of the United States, on Nov. 28, held the telegraph company liable for more than $300 damages. The message was written on a telegraph blank, which contained an agreement that in case of non-delivery the telegraph company would be liable for only the amount received for sending the message. The trial court awarded a judgment of several hundred dollars in favor of the sender, holding that the contract was invalid because it was in conflict with a State law that regulated the liability.

Municipal Street-Lighting Plant Voted for Milwaukee.—At the recent election in Milwaukee it was voted to appropriate $550,000 for the installation of an electric generating plant and distribution system to light the city streets, public parks and municipal buildings, $300,000 of this amount to be raised by mortgage certificates and $250,000 by issuing bonds. The present plan for the erection of this station is said to contemplate the use of waste steam from the city garbage-destructor plant on the lake front, where tests made some time ago showed that 21,000 lb. of steam at 70 lb. per square inch pressure is available each hour during the operation of the incinerating apparatus. There are 3000 street-arc lamps needed for Milwaukee, but the plant it is expected to build with the present appropriation would be able to operate only about one-third of this number. A number of city water-works pumps in various parts of Milwaukee may also later provide a day load for the municipal electric plant.

Electric Signs in Chicago.—On Dec. 31, 1909, there were 5231 electric signs in Chicago.

Incandescent Street Lighting Under Test in Washington.—The Commissioners of the District of Columbia are making rather extensive experiments in the use of high-candle-power incandescent electric lighting units to replace arc lamps. Temporary poles have been put up on Pennsylvania Avenue, in Washington, and a record will be kept of comparative costs and volume of useful light.

Proposed Government Transatlantic Cable.—A proposal is said to be under consideration for a government-owned cable between Great Britain and Canada. The route was surveyed in 1860. It runs from Scotland to Faros Island, thence to Greenland and thence to Hamilton Inlet, Labrador. The estimated cost is $4,250,000, which, it is figured, would permit a charge of 9 cents a word for ordinary and 5 cents for press messages.

Vast Deposits of Lignite in Texas.—The latest estimate of the fuel deposits of the State of Texas, made by Mr. W. D. Phillips, director of the bureau of economic geology at the State University, indicates that 31,000,000,000 tons remain after the removal of nearly 20,000,000 tons since mining commenced in 1884. Of the existing beds, 8,000,000,000 tons is reported to be in bituminous coal and 23,000,000,000 tons in lignite. The workable coal area of the State is nearly 10,000 sq. miles.

Electric Radiators for Crane Cabs.—A manufacturer of electric heating apparatus reports that a large sale has been made during the present season of electric radiators to the steel companies and other operators of outdoor electric cranes for heating the cabs in cold weather. The electric heater is convenient and compact, since electric energy is delivered directly to the crane cab and the consumption of the resistance units is small compared with the energy taken by the crane outfit.

International Refrigeration Association in America 1913.—The International Association of Refrigeration, comprising manufacturers of refrigerating apparatus from all over the world, will hold its next convention in the United States in 1913. Mr. Theodore O. Vilter, president of the Vilter Manufacturing Company, Milwaukee, has just returned from the last convention of the association, held at Vienna, at which 740 delegates were present. There he urged the selection of this country as the next meeting place, and his invitation was accepted by the association.

New York Branch of the N. E. L. A.—On Nov. 10 a New York branch of the National Electric Light Association was organized, membership in which is open to employees of all the electric lighting and motor service companies of Greater New York. Dr. Charles P. Steinmetz made the principal address of the evening, brief speeches also being made by Messrs. W. W. Freeman, T. C. Martin and H. H. Scott, of the National Electric Light Association. Although this was a meeting preliminary to organization, nearly 400 members have already joined. The first regular meeting will be held on or about Dec. 10, subject to the call of the temporary chairman, Mr. J. W. Lieb, Jr.

Burglar "Ads" Criticised.—One advantage of the use of electric light in residences is that it is instantly available and may be controlled from a distant point in case a burglar gets in the house. This contingency is perhaps rather remote in the ordinary household. Nevertheless, the possibility is there and the usefulness of electric light in this respect has been advertised not infrequently by central-station companies. Advertisements of this character have been used in Chicago, but now an "Old-Timer" writes to the papers to say that these ads are "no credit to the fair name of our city." The "burglar" signs should be removed at once, he declares.

Fourteen-Thousand-kw Turbine Units for Minneapolis.—The Twin City Rapid Transit Company, operating the electric railway systems in Minneapolis and St. Paul, Minn., is reconstructing its power plant at Minneapolis and is now arranging to install the first of several 14,000-kw, 25-cycle vertical-type turbine-generator units. Two 5000-kw turbine units have recently been rebuilt and fitted with forced draft, making them available for generating 9000 kw each. Four 3500-kw vertical-type, engine-driven generators are being removed to make way for the 14,000-kw turbines to be installed in their places. The company is also rebuilding its boiler-room, adding to the steam-producing equipment. These changes are being made under the direction of Mr. E. H. Schofield, engineer of the power and equipment department of the company.

A Flyball Recording Frequency Meter.—For recording the actual periodicity on the 30,000-volt, 25-cycle transmission lines of the Great Northern Power Company entering the terminal substation at Duluth, a recording frequency meter employing the principle of the flyball-governor has been installed near the switchboard. This instrument was devised by Mr. W. N. Ryerson, manager of the Great Northern Company, and comprises a small synchronous motor energized from the station buses, which drives an engine-type flyball governor. The sliding collar of the governor is arranged to move a syphon pen over a ribbon record which is advanced at constant speed. Any change in the line frequency thus affects the speed of the synchronous motor, in turn raising or lowering the flyballs and sliding collar to which the curve-drawing pen is attached.

Delays to Telephone Construction for Automatic Service in Chicago.—Through their attorneys, the receivers for the Illinois Tunnel Company have made a complaint to the Mayor and Commissioner of Public Works of Chicago that they have been delayed in line-construction work for the new automatic telephone system for Chicago by the action of city officials. It is alleged that the company's chief engineer has made repeated application for permission to erect poles and open streets and that the city has delayed taking action in the matter. The receivers say that they are anxious to have the automatic system in operation by the time limit of the ordinance, but that allowance must be made, of course, for the hindrance to their work by the delays in granting permits. The city officials say that there is no desire to hamper the company, the only desire being not to issue permits unless the company is ready to begin work at once.

Spring Convention of New England N. E. L. A. Section.—The annual meeting and convention of the New England Section of the National Electric Light Association will be held at the American House, Boston, on Wednesday and Thursday, March 15 and 16, 1911, including a banquet on the evening of the 16th. At a meeting on Nov. 12 the executive committee decided upon a program of three papers and in addition will make the question of central-station rates the dominant note of the convention. A committee will study the rate problem and make a report to the convention after the banquet on the 16th. The subjects of the papers are as follows: "Development and Application of Electricity to Domestic Purposes," "Rotary Condensers," "The National Electric Light Association System of Accounting as Applied to Small Plants." In order to permit full discussion one paper will be read at each session and the limitation of the number of papers to three has been purposely planned in order to enable justice to be done to each topic. The first annual convention of the New England Section, which was held last spring in Boston, was generally voted the most successful and profitable meeting of electrical interests ever held in New England, and it is anticipated that the 1911 convention will be still more enthusiastic.

STATION OF THE EMPIRE DISTRICT ELECTRIC COMPANY.

Steam Turbine Plant Equipped for Storing Coal Under Water and Operating in Parallel with Hydroelectric and Gas-Engine Stations.

By M. R. Bump.

THE development of the electric central station for the supply of electrical energy to the lead and zinc mines of the so-called Joplin district of Missouri, Kansas and Oklahoma has been worked out on a comprehensive scale by the acquirement of the existing properties in the district and the erection of a central generating station with an initial installation of 15,000 kw.

The Empire District Electric Company was organized in October, 1909, by Henry L. Doherty & Company, of New York City, and acquired all of the property of the Consolidated Light, Power & Ice Company and the Joplin Light, Power & Water Company, which properties controlled the electric business in Joplin, Webb City and Carterville, Mo., and Galena, Kan. The Empire company also acquired the majority control of the Spring River Power Company, which company supplied energy to motor circuits in the mining district from a hydroelectric station of 4000 kw normal rating and an auxiliary steam plant of 2500 kw rating.

Immediately after the organization of the Empire District Electric Company contracts were entered into for the erection of a modern 15,000-kw steam-turbine station. This type of plant was selected after careful consideration of the fuels available, namely, coal, natural gas and fuel oil. The location selected is at Riverton, Kan., where railroad facilities and water supply are most convenient. The plant is located on the storage reservoir of the hydroelectric development, where ample water supply is always available for condensing and boiler-feed purposes.

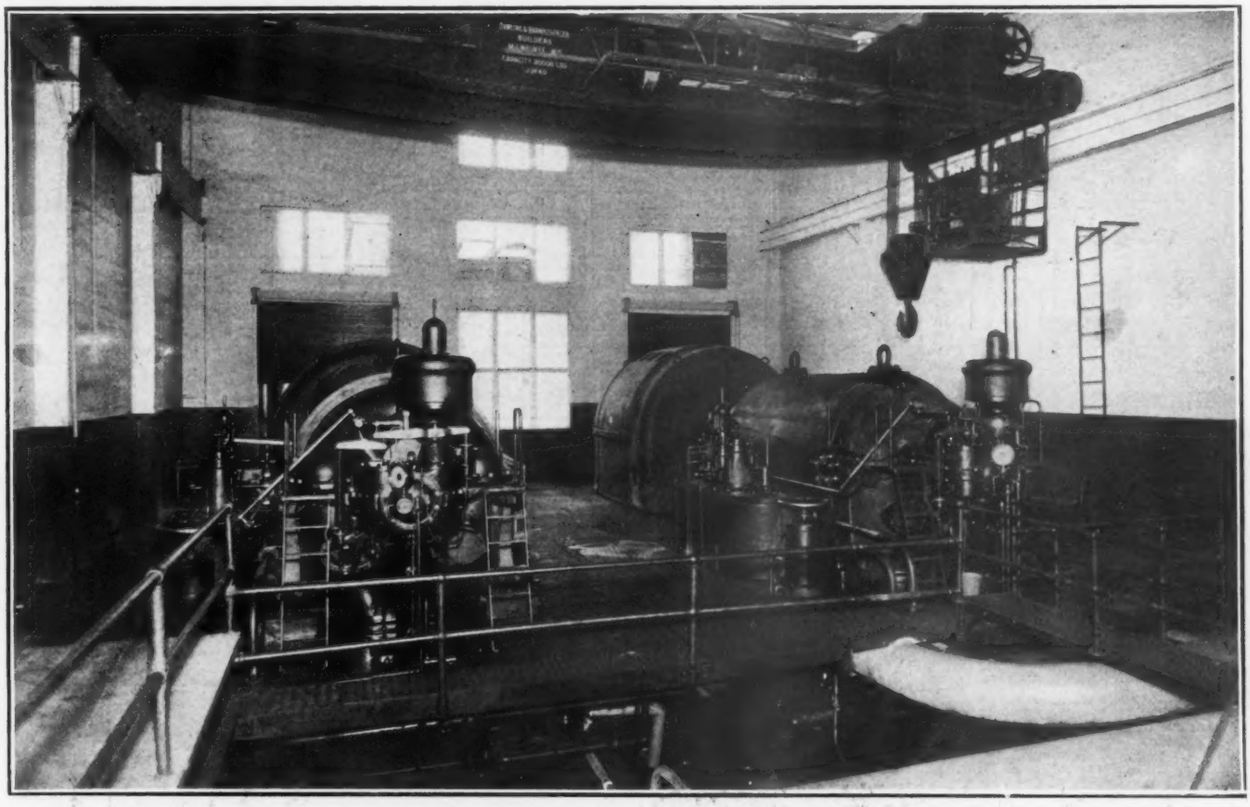


Fig. 1—Interior of Generating Station.

STEAM EQUIPMENT.

The steam equipment of the plant consists of 16 500-hp Stirling boilers, each equipped with superheaters and with Green chain grate stokers fed from hoppers running lengthwise of the boiler-room between the two aisles of boilers.

COAL SUPPLY.

Coal is received on a double switch graded to bring the full cars to one end and deliver the empty cars to the other end. From the switches the cars are pulled up an incline by a motor-driven hoist and hauled over the coal storage on a steel trestle. The coal shed consists of a concrete structure 50 ft. by 150 ft. with side walls 34 ft. in height and with solid concrete floor. The structural framework above is designed to carry a monorail, grab-bucket hoist of 1½ tons capacity and operated by electric motors. This hoist is suspended from an 18-in. I-beam and by means of a switch can be run out directly over the cars or at either side of the cars to deliver to or take coal from the storage space beneath the railroad trestle. The monorail extends directly into the boiler-room and over the bunkers in the boiler-room and in regular service will deliver coal from the cars or storage to the boiler-room bunkers. It can also be used to unload cars when dump cars are not available. The trolley motors are designed for a speed of 400 ft. per minute along the monorail and the hoist motors for a lifting speed of 120 ft. a minute. Water and drain connections are installed so that coal may be stored under water.

ASH-HANDLING EQUIPMENT.

The ashes drop from the chain grates into hoppers which are sloped toward a center aisle in the basement. The ashes are handled through a double line of suction pipe with openings opposite the doors on the ash pits. The suction equipment, designed and installed by the Darley Engineering Company, New York, consists of the double line of 8-in. suction pipe leading to an overhead tank of 40 tons capacity located outside the boiler-room. Ashes can be discharged from this tank into railroad cars or wagons as desired. The suction apparatus consists of a special Sturtevant exhauster direct-

conected to a 50-hp General Electric steam turbine which runs at 3600 r.p.m.

STEAM PIPING.

The steam header consists of a complete loop of 15-in. steel pipe extending around the boiler-room. The pipe is made in extra lengths and all joints are of the Van Stone type with wrought-steel flanges. All boiler connections to the header are made through nozzles 6 in. in diameter welded into the main header.

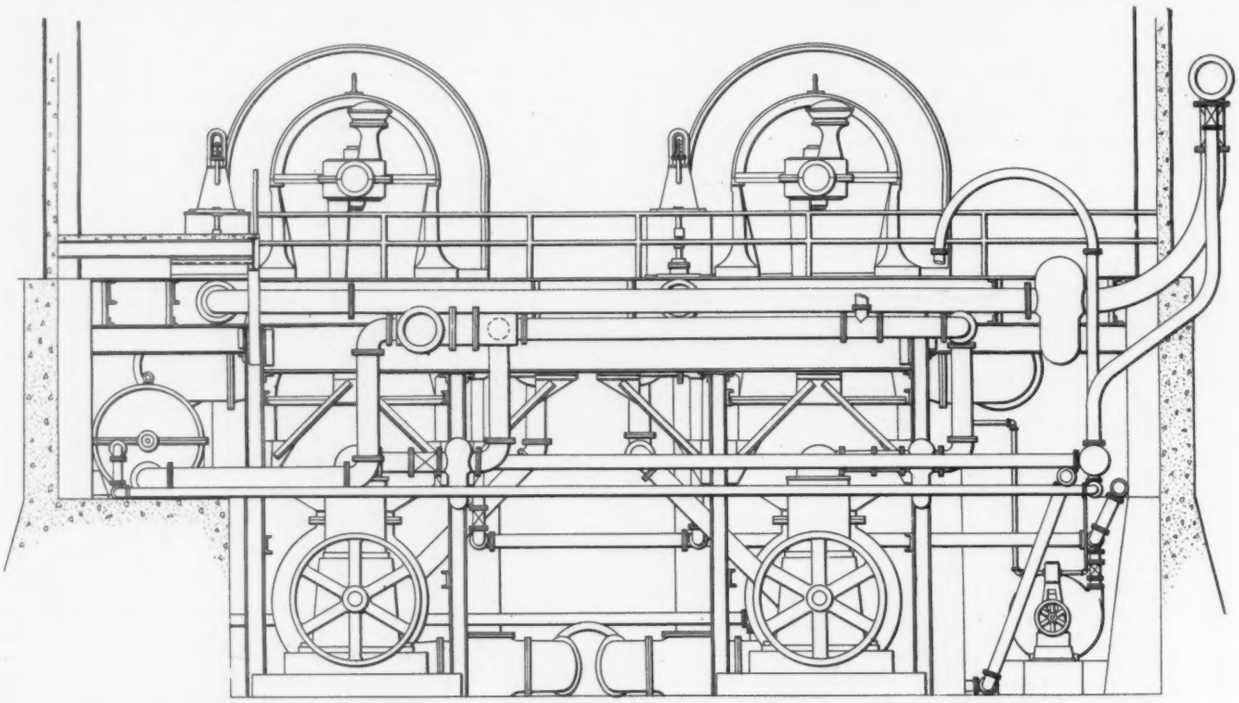


Fig. 2—Arrangement of Turbines and Auxiliaries.

AUXILIARIES

The auxiliaries consist of three Westinghouse duplex boiler-feed pumps, two engine-driven, single-stage pumps for lifting water into the heaters, two 5000-hp Cochrane open feed-water heaters and purifiers and a 30,000-gal. storage tank. The exhausts from the boiler-feed pumps, stoker engines, ash-fan turbine, pump engines and condenser engines empty into the feed-water heaters.

Fig. 3—Boiler Equipment.

STACKS.

There are two Custodis radial brick stacks each 14 ft. inside diameter and 250 ft. high. Each of these stacks is connected by means of overhead steel breechings to eight boilers.

BUILDINGS.

The buildings consist of a boiler-room 80 ft. by 150 ft., a turbine-room 50 ft. by 80 ft. and a transformer room 30 ft. by 80 ft. and have been designed with the view of extending the turbine and transformer rooms when additions are made and a duplicate boiler-room unit would then be constructed. The buildings are all self-supporting steel structures with reinforced-concrete walls, rolling-steel doors and steel-truss roofs. The boiler-room roof is of concrete tile built up on expanded metal and the turbine and transformer roofs are of book tile covered with composition roofing.

GENERATING EQUIPMENT.

The present generating equipment consists of two Westinghouse double-flow, horizontal turbine units. The generators are three-phase, 25-cycle, 1500-r.p.m., 6600-volt machines with a normal rating of 6000 kw at 80 per cent power-factor, but guaranteed to carry 25 per cent continuous overload at that power-factor and 50 per cent overload for one hour. The exciters consist of a turbine-driven 125-kw set and a motor-driven set of the same rating.

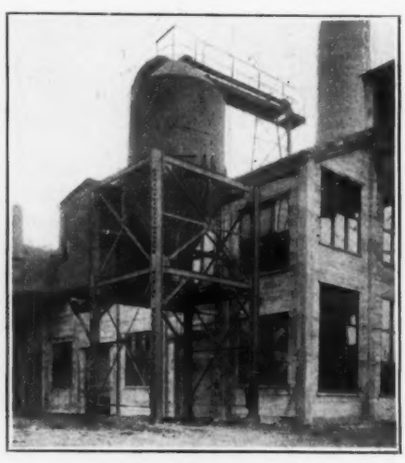


Fig. 4—Ash Tank.

Each turbine is equipped with a Westinghouse Leblanc condenser mounted directly beneath the turbine and suspended from its bed plate. The steam enters the condenser through

a special Y-casting which contains the condenser head. The pump unit, consisting of the circulating pump and the special centrifugal, dry-vacuum pump mounted on the same shaft. is suspended from the condenser chamber and is driven through a flexible coupling by a 150-hp Westinghouse high-speed engine. By this method of mounting the entire condensing equipment is under the turbine bed plate and only the engines extend beyond the lines of the bed plate. These engines could have been kept inside the lines, but the shaft was extended to locate the engines more conveniently for operation and repairs.

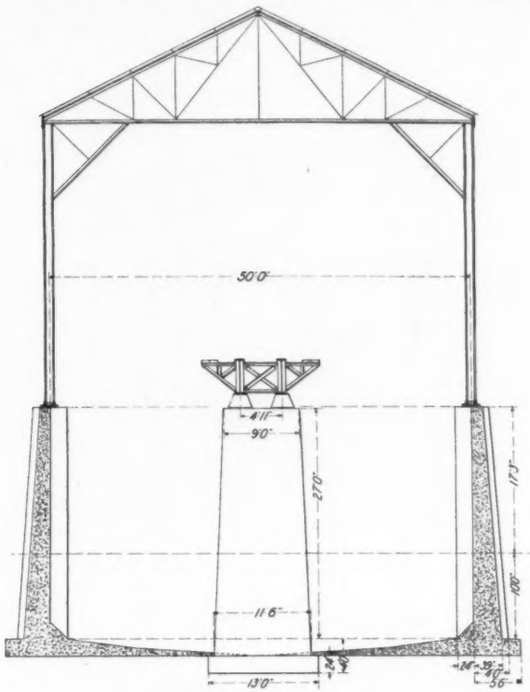


Fig. 5—Section of Turbine Room.

SWITCHBOARDS.

All main switches, both on 6600-volt and 33,000-volt leads, are electrically operated from the board, which consists of eight standard panels as follows: Two exciter panels, two generator panels, three high-tension control panels and one house-service panel. The panels are of black, marine-finished slate and the instruments are all of the round switchboard type.

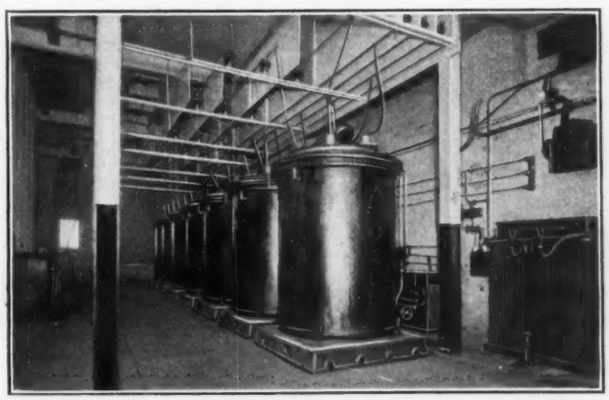


Fig. 6—Transformer Equipment.

SWITCHING AND TRANSFORMING APPARATUS.

Each generator is controlled through a Westinghouse electrically-operated oil switch and circuit-breaker and a second set of these breakers controls the connections to the transformer buses. The transformers consist of two banks of 2000-kw water-cooled, oil-insulated transformers with one spare transformer that can be connected to either bank. These transformers are delta-connected for 6600-33,000 volts. The high-tension leads from the transformers to the buses and each of the three outgoing lines are controlled by electrically operated oil circuit-breakers, each leg of which is inclosed in a separate steel tank. Each of the three outgoing lines is protected by electrolytic lightning arrests and by oil-immersed choke coils.

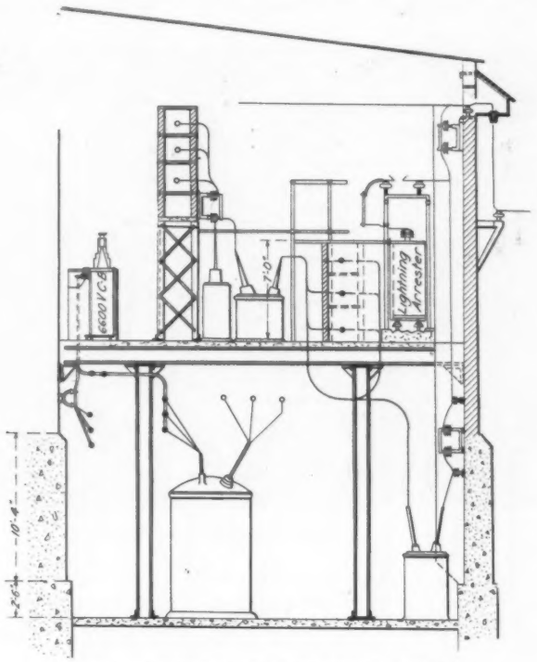


Fig. 7—Section of Transformer Room.

The bus compartments, which are mounted on a steel superstructure, are built of pressed brick and Vermont slate. Barriers between all high-tension wiring are built of asbestos board to cut down the weight.

OPERATION.

The new plant will be operated in parallel with the water-power plant and with an auxiliary gas-engine plant containing two 500-kw gas-engine units about twenty-five miles from the main station. The gas-engine plant will be used for emergency service and to help the voltage regulation on heavy peaks.

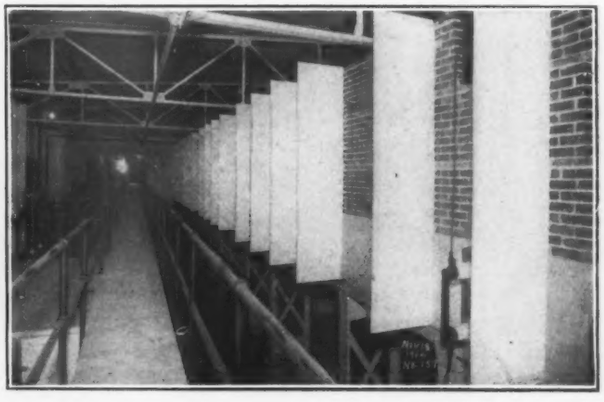


Fig. 8—High-Tension Bus Compartments.

The water-power has a maximum output rating of about 3000 kw and sufficient water-storage capacity so that it can be operated over the peaks at times of average or low water. It will also be used to advantage to carry a small percentage of the total load and to take the wattless current off the main

steam plant and thus in effect increase the capacity of the steam plant.

CONSTRUCTION.

Excavations for foundations were started Nov. 4, 1909; the first concrete work was started Dec. 15; erection of steel work for buildings began Jan. 27, 1910; boiler and stack erection was commenced Feb. 26, 1910, and turbine and switchboard erection started March 28, 1910. The first unit was ready to start June 15, but operation was delayed on account of a coal strike. The first unit was therefore started July 14, and connected to the lines Aug. 11, 1910, the delay again being caused by coal shortage.

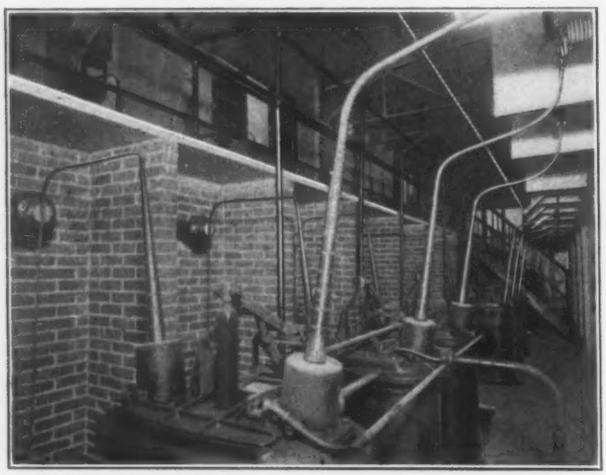


Fig. 9—Oil Switches.

TRANSMISSION LINES.

Two of the lines leaving the station connect to the two ends of a belt line sixty-four miles in length, forming a complete loop around the district. The third outgoing line connects the plant with the old Spring River transmission line, which forms an almost direct line through the center of the new belt. The transmission lines are carried on Idaho cedar poles spaced 150 ft. apart. The standard poles are 35 ft. high with 8-in. tops. Two standard arms are used on the top arm, one of the three transmission wires is mounted on one pin and a galvanized-iron ground wire on the other pin. The second arm carries the other two transmission wires. A telephone line is carried on brackets and transposed every second pole and a second ground wire is mounted on brackets between the telephone wires and the high-tension wires. Both iron wires are grounded every second pole with independent grounds. The transmission wires are transposed every two miles on an average. All right-angle bends are made on special four-pole constructions.

SUBSTATIONS.

The standard substation buildings are portable steel structures covered with galvanized, corrugated iron. The standard high-tension equipments consist of a high-tension oil switch for opening the main belt line in case of trouble, a high-tension oil switch on the leads to the transformers, and a set of electrolytic or low equivalent lightning arresters. The transformers are all 250-kw, delta-connected, 33,000-2300-volt, oil-immersed, self-cooled units.

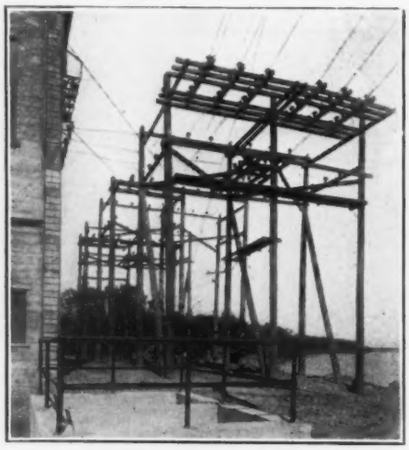
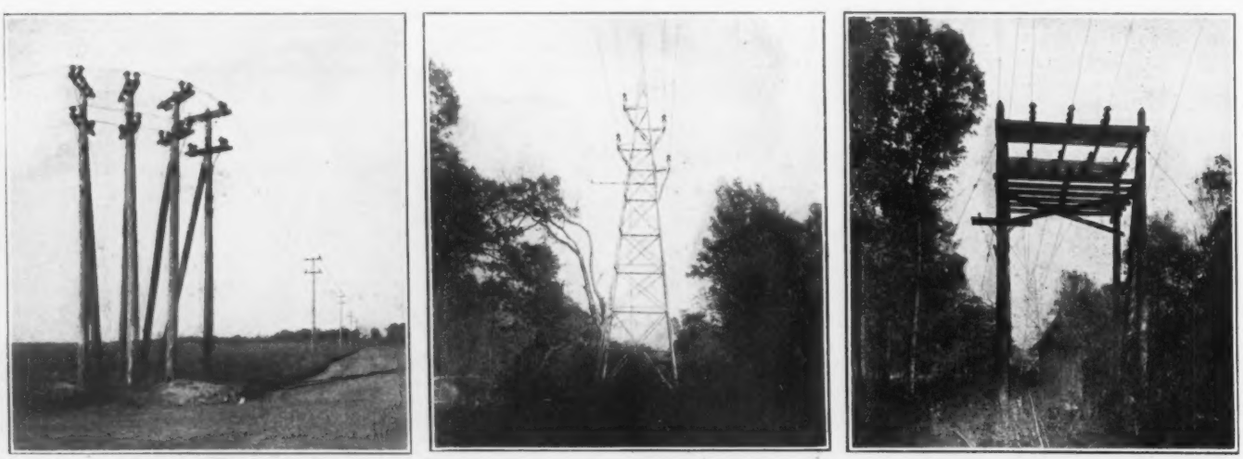


Fig. 10—Wooden Terminal Pole Structure.

SECONDARY DISTRIBUTION.

Electrical energy for motor circuits is distributed and sold at 2300 volts and practically all motors above 25 hp in rating are 2300-volt machines. The principal field for the sale of this energy is the lead and zinc mines of the district. The size of mining installations varies from 30 hp to 2000 hp in total requirements. The average installation requires about 400 hp, divided approximately as follows: For driving the concentrating plant, 100 hp to 150 hp, operated at full load from ten to twenty hours a day; for driving compressors for air drills, 100 hp to 150 hp, usually operated eight hours a day; for operating hoists and trams, 60 hp to 100 hp. The hoisting is all done in cans weighing from 800 lb. to 1200 lb., and the hoisting speed varies from 600 ft. to 1500 ft. per minute, according to the depth and the number of cans required. The average depth of a shaft is about 200 ft. The motors used are special 220-volt hoist machines varying in size from 20 hp to 60 hp. For



Figs. 11, 12 and 13—Wooden-Pole Corner, Steel Tower Line and Wooden Anchor Poles.

pumping the horse-power required varies from 10 to 120 and these motors operate every hour in the year at practically constant load.

Lighting service is supplied to the various towns through frequency changers which generate current at 2300 volts, 60 cycle, two-phase.

The field for motor circuits covers an area thirty miles square

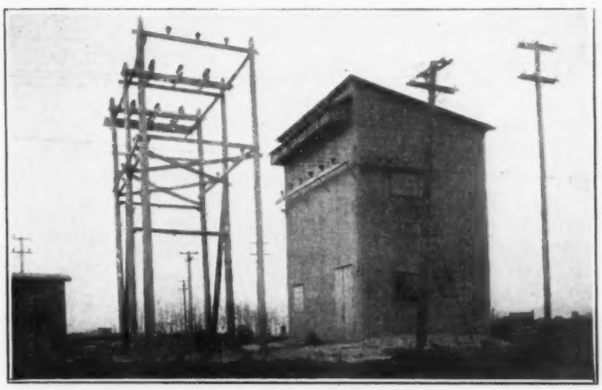


Fig. 14—High-Tension and Low-Tension Circuits at Substation.

and a canvass of this district shows installations of private plants in excess of 130,000 hp, of which not less than 80,000 hp is in daily service. Furthermore, this field is growing rapidly and the growth will probably be not less than 10,000 hp per annum. Other industries in the district include the Picher

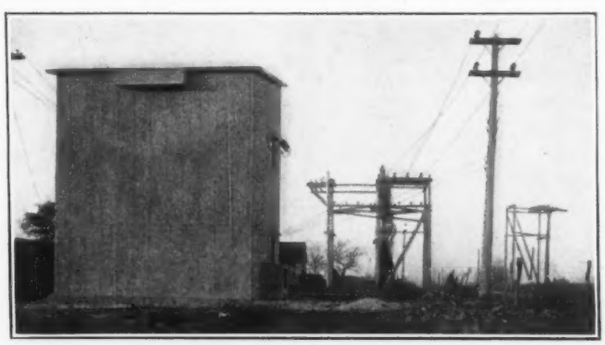


Fig. 15—Substation Circuits.

Lead Works, the largest litharge and paint pigment manufacturing plant in the world operated throughout by electricity; 100 miles of street and interurban railways with 30 miles of extensions under way; flour mills, foundries, manufacturers of mining machinery, structural steel and bridge works, smelters, the Carthage limestone quarries, etc.

The field for lighting business includes Joplin, Webb City,

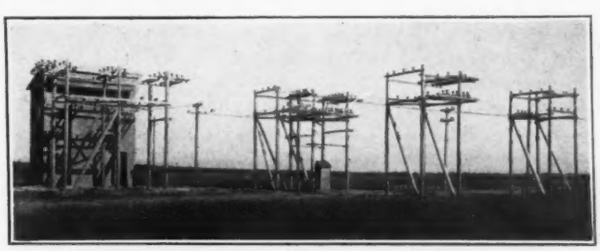


Fig. 16—Special Wooden-Pole Line Structure.

Carterville, Galena, Oronogo, Prosperity and other smaller towns having a combined population of over 100,000. A new business campaign inaugurated about ten months ago has increased the sales of electricity for lighting 50 per cent in that time and a new business campaign for the sale of energy for motors was recently inaugurated and has already added 4000 hp in commercial motor load.

WATE POWER AND COMBINATION STEAM PLANTS AT JANESVILLE, WIS.

The system of the Janesville Electric Company, supplying electrical energy for lighting, motor and railway service in the City of Janesville, Wis., presents an interesting combination of four low-head water-power plants, two of them combination steam plants and one a gas-engine auxiliary station. The four water-power plants in their order, descending the Rock River, on which they are situated, are: The 150-kw Fulton station (1), generating and transmitting at 6600 volts two miles to the In-

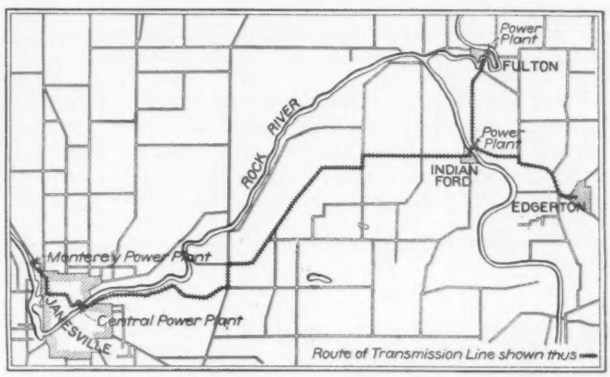


Fig. 1—Map of Transmission System, Showing Location of Plants.

dian Ford plant (2), where 2300-volt generators are installed, besides a 50-hp auxiliary gas engine used during periods of low water. At this station transformers are installed stepping up to 6600 volts for the ten-mile transmission to Janesville. The main generating plant at Janesville (3) contains a combination of steam, water-wheel and alternating-current motor-driven units for supplying the direct-current Edison service and street-railway load. The other combination steam plant feeding into the Janesville station is the Monterey plant (4), developing energy from the Rock River, near the city limits. This Monterey station contains a 275-kw, 2300-volt alternator which can be

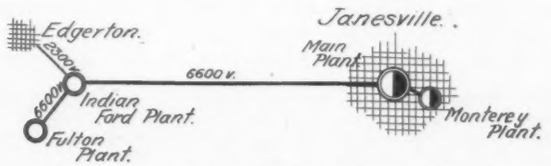


Fig. 2—Water-Power and Combination Steam-Plant System at Janesville (Wis.)

driven by either four 100-hp water-wheels or a 350-hp compound Corliss engine. It transmits back to the main plant at the distribution pressure 2300 volts. The City of Edgerton also derives its lighting over a 2300-volt line, three miles in length, from the generator buses of the Indian Ford plant. Messrs. D. C. and W. B. Jackson were the consulting engineers for the several plants.

The Janesville plant is interesting in the arrangement for driving its direct-current generators by either four 150-hp water-wheels, a 350-hp Corliss engine, a 113-hp, 6600-volt alternating-current motor or a 200-hp, 2300-volt alternating-current motor. Or, in case the other alternating-current generators at Fulton, Indian Ford and Monterey are shut down, the synchronous motors can be driven as generators by either the water-wheels or the engine supplying alternating-current energy to the system. The arrangement of these machines, belted to a long shaft running at 215 r.p.m., is shown in an ac-

companying sketch. The two 75-kw, 125-volt generators are connected in series across the three-wire lighting system, to the outers of which both the 85-kw, 250-volt belt-driven generator and the 113-kw high-speed, engine-driven generators may be connected. The two 100-kw, 250-volt generators are connected in

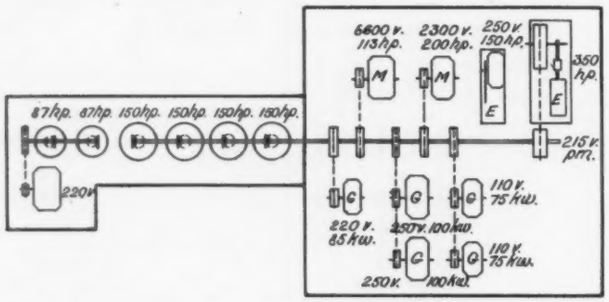


Fig. 3—Arrangements of Water-Wheels, Motors, Engines and Generators in Main Plant of Janesville Electric Company.

series to serve the trolley system, although either may be withdrawn and connected to the outers of the three-wire system.

During normal stages of the Rock River, with all the plants generating their rated output of the alternating-current energy transmitted into Janesville, part is distributed as such in the

Fig. 4—Upper Dam, Janesville, Wis.

outlying alternating-current district of the city, while the remainder is utilized by the alternating-current motors at the main plant to assist the water-wheels in driving the direct-current generators. When the Fulton and Indian Ford plants are shut down during periods of light local load the alternating-current

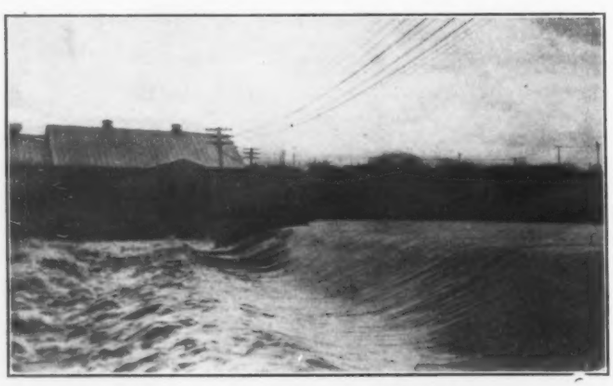


Fig. 5—Lower Dam, Janesville, Wis.

service is supplied by the synchronous machines, driven as generators by the water-wheels, or during low water by the engine. The main-line shaft to which all of these machines are belted, or geared in the case of the water-wheels, is sectionalized by clutches so that portions of the plant can be operated separately if desired.

The system at Janesville is also notable for its large day load, a recent census among local manufacturers having shown that 85 per cent of the power developed in the city is sold by the electric company to motor-driven plants. Mr. P. H. Korst is secretary and general manager of the Janesville Electric Company. Other articles on the Janesville plant have appeared in the issues of Dec. 31, 1904, and March 10, 1906.

CENTRAL-STATION NOTES FROM PORTLAND, ME.

Electrical supply in the City of Portland, Maine, has been put upon a centralized basis during the past year by the establishment of the Portland Electric Company, which lately assumed the management of the Consolidated Electric Light Company and the Portland Electric Light & Power Company. The new organization has business headquarters in a building of its own in the heart of the city, at 121 Center Street, in sight of all eastbound and westbound traffic passing through Monument Square. Under the present administration a comprehensive system of electric generating plants and distributing services is being worked out, and the different properties are being handled upon a unified basis. The population of Portland is about 60,000 people, and the company serves in addition the towns of Sanford and Springvale, Maine.

The present electrical generating system consists of three generating plants, two being located outside the city. The city station is a steam plant which is used to supplement the service rendered by the outside stations, both of which are hydroelectric in type. One of the hydroelectric stations is located at North Gorham and the other is at West Buxton, Maine. Each station is connected with the Portland city station by a double transmission line, two low-tension tie lines being installed between step-down suburban substations and the steam-generating station, which is located on Plum Street in the marine district of Portland. There are no interconnecting transmission lines between the two hydroelectric plants except through the Plum Street station.

The North Gorham plant is located at Great Falls, on the Presumpscott River, and the dividing line between the towns of Gorham and Windham passes through the center of the stream. The station contains four 500-kw, 10,000-volt, three-phase generators driven by 33-in. Stilwell-Bierce water-wheels mounted on the generator shafts and operating under a head of about 40 ft. The power house is a one-story brick building connected with the water supply by steel penstocks carried upstream to the further side of a stone masonry and timber crib dam 35 ft. high, which crosses the river between the two towns named above. Each penstock is provided with a separate head gate, and the dam provides for the temporary storage of water discharged from Sebago Lake, 2.5 miles above. The lake and its tributaries have an area of about 100 sq. miles and the drainage area feeding the system is estimated at about 470 sq. miles. The daily discharge at the lake outlet is about 925 cu. ft. per second, and the flow from the lake is controlled by a stone dam below White's Bridge, which is owned by the Sebago Power Company, the latter being an organization of the owners of the riparian rights along the Presumpscott River. The water-wheels in the station are of the horizontal type, and two units are installed for each generator. Each generator is equipped with a 30-kw belted exciter and is wound for 10,000-volt service, there being no step-up transformer equipment in this plant. Energy is transmitted to the Deering district of the City of Portland over three three-phase circuits of No. 2 copper, the line being about fifteen miles long. The e.m.f. is lowered in two substations, one of which is fed with energy through each line, and each substation is connected with a third distributing center in the Deering district, which is further connected with the Plum Street power plant by two three-phase tie lines of No. 4-0 copper built for 2500-volt service.

The West Buxton station is located on the Saco River, which

divides the towns of Hollis and West Buxton at the plant. It contains four units of 750-kw rating each, operating under a normal head of 28 ft. The generators are directly driven by horizontal turbines of the double-flow, center-discharge type, each wheel being 48 in. in diameter and of S. Morgan Smith make. The yearly average discharge of the river provides for the delivery of about 5741 hp at the site of the plant, the maximum discharge giving a flowage capable of developing 15,967 hp and the minimum of 1440 hp. About 84 sq. miles of lake storage is utilized above the plant at present. The stream is crossed at West Buxton by a dam 300 ft. long which provides the necessary head for the turbines. The e.m.f. is increased from the generator value of 2300 volts to 22,000 volts for transmission to Portland over two lines, each of which consists of a three-phase circuit of No. 2 hard-drawn copper, the wires being spaced 30 in. apart in equilateral triangles. The length of the lines is about 17.5 miles. Lightning protection on the transmission lines is provided by guard wires of phonoelectric copper 0.11 in. in diameter run on the side blocks on the tops of the poles and grounded at every tenth pole. A private telephone line is installed 6 ft. below the transmission line on 10,000-volt porcelain insulators. The spacing of wires on the North Gorham line is 18 in. The transformer equipment at West Buxton consists of six General Electric water-cooled 500-kw units. The potential is reduced at a substation in the outskirts of Portland by six transformers of the same rating and make, oil-cooled, which deliver energy at 2500 volts for local distribution and service in connection with the steam plant. There are 1800 kw in transformers in service in the Deering substations in connection with the incoming North Gorham lines, so that the hydroelectric plants when running at normal rating deliver approximately 4500 kw to the city system for local consumption.

The Plum Street station is a two-story brick and concrete structure housing equipment rated at 2470 kw, 1660 kw being in machinery of the direct-current type and 810 kw in alternating-current machinery. The system of the old Consolidated company was mainly of the direct-current type. The Plum Street plant now contains six direct-current generators supplying energy to an Edison three-wire system in the business district of the city and two 2300-volt alternators delivering three-phase, 60-cycle energy to the local lighting and motor-service system. There are also three 500-kw, 250-volt, three-wire generators in this station, each being driven by a synchronous motor. By means of these motors the power-factor of the system has been raised to about 90 per cent. The boiler installation at Plum Street includes one 400-hp, two 250-hp and four 350-hp units, all being of the Babcock & Wilcox type, hand-fired and operated at 140 lb. per square inch steam pressure. The engine equipment consists of one McIntosh & Seymour, two Armington & Sims and five Ball & Wood outfits, with appropriate condensing apparatus.

Electric lighting rates to all new customers are 9 cents per kw-hour with a minimum of $12 per year per residence. For summer-residence lighting, which is a considerable portion of the company's business in the harbor and shore resorts near Portland, a rate of 15 cents per kw-hour is charged, with a minimum charge of $1.50 per month. The connected lighting load amounts to about 127,000 16-cp equivalents. Free renewals of carbon lamps of 8-cp rating and over are made in exchange for burned-out units. An allowance of 15 cents apiece is made for burned-out tantalum lamps of any size. The company's prices on tungsten lamps vary from 70 cents for the 25-watt size to $2.50 for the 250-watt units. For tantalum lamps the company charges 40 cents for 25-watt lamps, 50 cents for 40-watt lamps and 75 cents for the 80-watt lamps. The price of reflectors runs from 60 cents to $1. Frosted lamps are sold to customers at an extra charge of 5 cents each, and turn-down lamps at 45 cents and $1. The residence lighting returns average from $20 to $25 per installation per year. The service supplied by the company includes both 110-volt and 220-volt direct current and alternating current. The company has put out 1100 flatirons in the last eighteen months on thirty days' trial and it is estimated that 95 per cent of the irons were retained. The work was done chiefly through newspaper publicity. There are about 6000 customers on the company's books at the present time.

The base rate for electric motor service is 6 cents per kw-hour. A flat charge of $1 per month per horse-power is made for motor installations rated at 50 hp and above, in certain cases, with the addition of an energy charge of 2 cents per kw-hour. Up to 50 hp connected motor load the minimum charge is 50 cents per horse-power per month. The company also has a non-peak motor-service rate running downward from 7 cents per kw-hour on a sliding scale, the hours of non-service being from 4 to 11 p. m. between Sept. 1 and April 1. The discounts on the sliding scale run from 44 per cent to 75 per cent according to use. The connected motor load is about 7000 hp. In the shops of the Portland Company, general machinists, a motor installation rated at about 1000 hp is in service. The local street-railway company purchases 700 hp and the Sanford mills have recently contracted for about 2200 hp. Many miscellaneous applications of electric motors are made in Portland, including printing plants, binderies, grinding establishments, shoe shops, hotels, elevators and department stores. A few small refrigerating plants are also in service in the city. The company has ceased to do electric wiring and free repairing.

The office building of the company is a renovated structure into which the various departments moved a few months ago. It is provided with large display windows on the street level and the exterior is decorated with 284 front and cornice border lamps of 4-cp rating. Each window is lighted by six 100-watt tungsten lamps. A new-business department room, 45 ft. long and 20 ft. wide, is provided with a handsome counter for the renewal of lamps, below which are bins for lamp storage and on top of which is an installation of test outlets. Two meters are wired in the new-business department so that the comparative power consumption of different styles of lamps can be exhibited to prospective customers by means of plugs connecting the lamps with the meters. The latter are provided with glass fronts. In the upper part of the building are an assembly hall, operating offices, electrical laboratory and meter-testing department. The accounting and executive offices are on the street floor opposite the new-business department.

The officers of the company are: President, Mr. C. O. Bancroft; treasurer, Mr. Wilbur Tusch; assistant treasurer, Mr. P. H. Burrowes; general manager, Mr. J. A. Fleet, and superintendent, Mr. H. W. Eells.

SPECIAL USE OF ELECTRIC HEAT IN LACQUER SHOP OF LARGE BED FACTORY.

At ordinary room temperatures only a single coat of lacquer can be successfully applied to polished brass surfaces, because the alcohol solvent of each successive coat would, unless instantly evaporated, cut or dissolve the preceding coat, wiping it off and producing marking. Consequently, a single coat of thick consistency is usually applied, but at best such a single coat will be thin when dry, and will lack durability. A better way is to employ a number of successive coats of a thin durable material like English lacquer, keeping the part to be covered heated during the operation, so that each coat is instantly dried as applied, while those beneath remain unaffected.

For heating such parts, as in the manufacture of brass beds, where the lacquering of the polished surfaces is important to the satisfactory service of the product, gas-heated ovens have heretofore been employed. In these ovens the parts were heated from ten to thirty minutes, quickly transferred to the lacquering table, and a coat applied before the temperature fell below that needed for drying the lacquer as applied. This operation had to be repeated for each of the ten or fifteen coats

given to the best work. Besides the time consumed in heating the pieces and in transferring them from the ovens to the tables temperatures higher than those actually required for drying the lacquer had to be employed to allow for the cooling of the brass parts in transit to and during the lacquering operation. This excessive temperature tended to bake the lacquer, causing it to darken and so detract from the appearance of the brass surface.

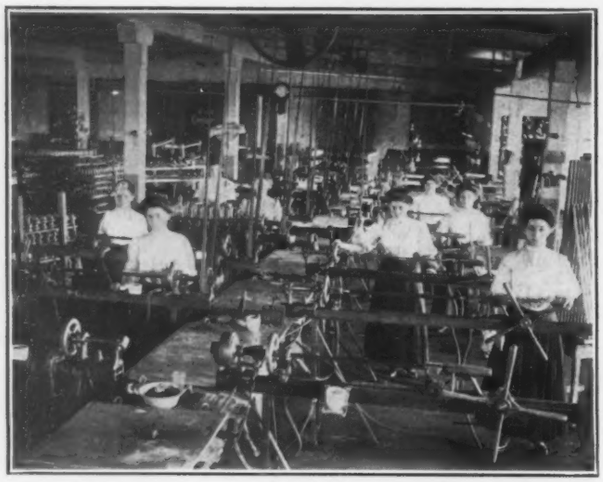


Fig. 1—Lacquering Brass Parts While Electrically Heated.

A method of keeping the brass parts heated electrically while being lacquered is in use at the plant of the Simmons Manufacturing Company, employing the invention of Mr. W. W. Vincent, general superintendent of the company. The method consists in traversing the metal parts with large currents of electricity at low potentials, delivered from step-down transformers. More than 100 machines employing this principle are now in use at the Simmons factory. These machines are variously designed for handling the differently shaped parts encountered in the manufacture of beds, of which the company builds several thousand daily. The low-tension currents employed range from 500 amp to 2000 amp, depending on the shape and cross-section of the pieces to be heated.

Fig. 2—Method Formerly Used for Lacquering with Gas-Heated Ovens.

Fig. 4 shows a typical machine of the kind developed for the Simmons installation, as used for the lacquering of long straight rods, tubes or parts. The design follows generally that of a wood-turning lathe driven by a belt and pulley, except that the center tools are replaced by special contact mandrels which fit snugly over the brass section when the tail stock is pressed up tightly by means of its handwheel rack-and-pinion. Each of the contact pieces is provided with large cylindrical surfaces on which V-shaped copper brushes bear, relieving the mechanical bearings of carrying any current. Supported on the I-beam which forms the shears of the machine is a copper busbar extending throughout the length of the tail-stock travel,

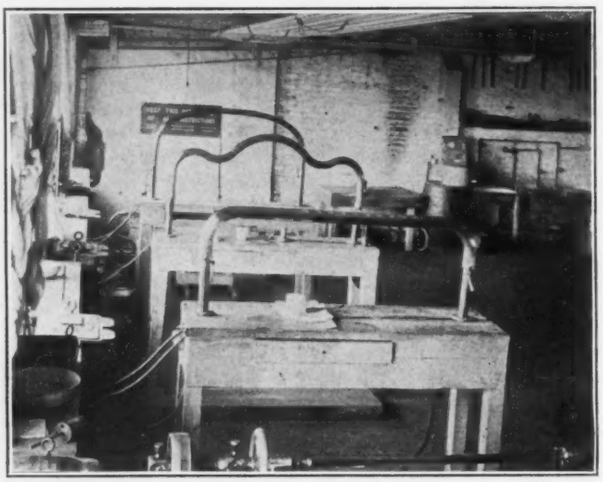


Fig. 3—Brass Bed Head and Foot Pieces Electrically Heated for Lacquering.

which is borne upon by a brush leading to the mandrel contact before mentioned. This conveys current to the movable tail-stock mandrel at any position on the shears.

Near the pulley of the machine is the energizing switch, inserted in the 440-volt side of the step-down transformer. The secondaries of these transformers are provided with 1.5-volt, 2.5-volt and 5-volt taps for various lengths and cross-sections of brass parts. In the practical use of these machines it is found that the current need be turned on only for a few seconds at a time, the part being almost instantly heated. Then, while it is rotated slowly by the belt pulley or hand wheel, the lacquer is quickly applied. The required number of coats can thus be given in quick succession, without returning the part to an oven to be reheated before each coat, as was formerly necessary. Another illustration (Fig. 3) shows the adaptation of the same principle to the brass head and foot pieces of beds. Here special expanding contacts are used which clamp the interior surface of the hollow tubing.

The expense of operating these machines, compared with the high labor cost and time taken with the old ovens, is slight. The current demands of the 440-volt primaries of the transformers are reported to be so small as not to be noticeable among those of the large number of motors operated at the Simmons factory. Each machine is turned on only momentarily and, as few are in demand simultaneously, the aggregate tax upon them remains small. The saving in cost is proportional to the great economy of time made possible by the electric-heating method over the old gas ovens.

Fig. 4—Machine for Electrically Heating Brass Bed-Post While Being Lacquered.

ESTIMATED COST OF AN INDUSTRIAL ELECTRIC PLANT.

An interesting estimate of the cost of installing and operating an industrial steam-electric power plant was presented recently in Massachusetts in the case of the Otis Company vs. the Ludlow Manufacturing Company. It appeared in evidence that the Ludlow company had, by building a new dam, encroached upon a water-power privilege owned by the Otis Company, and, as claimed, impaired its value to the extent of an average of 1247.6 hp, this impairment being estimated at about 782 hp in the driest month and 1435.5 hp in the wettest month of the year. The normal available power which the Otis Company could have developed at its own dam averaged 1694.9 hp, with an estimated yield of 1032.5 hp in the driest month and 2020.7 hp in the wettest. One question at issue was the cost of installing upon

TABLE I —TOTAL ESTIMATED COST OF PLANT.

Value of land to be purchased	$4,000
Cost of relocating 1600 ft. R.R. tracks and 900 ft. of highway	7,500
Engine house, boiler house and stack	22,779
Coal pocket and trestles	11,794
4 water-tube boilers, 1050 hp at $14	14,700
Foundations	350
Economizer, 360 tubes at $11	3,960
" setting flues, dampers, etc	1,500
Feed pumps and foundations	550
Feed water heater and foundations	450
Steam piping and covering	10,000
2 cross-compound engines, 750 hp each	32,500
Foundations for engines	3,500
Condensers	4,000
2 electric generators, 600 kw	21,000
2 exciters, 20 kw each, and 1 steam exciter set	1,000
Switchboard, wiring, etc	3,500
Lines	2,500
Engineering and supervision	9,951
Total	$155,534

the premises of the Otis Company an independent steam and electric plant that should be capable of supplying, for the same purposes and to equal advantage in their use, sufficient electric current for replacement of the power diverted.

The engineering experts in the case, Messrs. Lockwood, Greene & Company, of Boston, replied to this inquiry by stating that in locating an independent steam and electric plant to supply diverted power it is not necessary to install it at or near the water-power station, which was situated about 4500 ft. down stream from the Palmer Mill, to secure the maximum fall of the river, since such a location for the steam plant would entail an unnecessary loss in electrical transmission to the mill and would be inconvenient for delivery of coal and for other reasons. The engineers assumed for the proper location of the independent plant a site behind the existing boiler house of the mill, which site was about the only place where sufficient area could be secured for it convenient to railroad lines for coal delivery and also accessible to a condensing water supply. In order that the new steam plant should meet the power demands under the varying conditions of supply from the impaired water-power, the engineers estimated on an engine plant of two units of 750 hp each, and it was pointed out that by varying the steam pressure these units could be made to yield power as needed in amounts varying from 782 hp to 1435 hp. It was noted that the power diverted from the water-power plant was effective power at the wheel-shaft and it was pointed out that an equivalent power from the steam plant would have to be figured as so-called brake-hp on the engine shaft. Hence, in fixing the size of the engines to be used an allowance was made for engine losses, thus taking the mechanical efficiency into account. This was estimated at 93 per cent of the load, although it was recognized that it would vary somewhat with the loads. Hence the engine plant had to meet conditions of load ranging from 841 hp to 1544 hp with an average of 1342 ihp. This independent plant required electric transmission lines to carry power into the mill buildings in the same manner as the hydraulic plant, but without transformers and with less line loss from the shorter distance, since the plan proposed located the steam plant opposite the mills where the power is required and not as remote as the water station.

The total estimated cost of such a plant is given in Table I and the estimated cost of operation and maintenance in Table II.

TABLE II —ESTIMATED COST OF OPERATION AND MAINTENANCE.

Chief engineer	$1,200
Assistant	921
2 firemen for 8 months, 1 fireman for 4 months	922
Coal and ash handling	800
Oil, waste, etc. approximately	750
Fuel for 1247.6 brake hp average output, 4840 tons at $4.38	21,199
Maintenance and repairs, 1 per cent on total cost	1,440
Depreciation allowances:	
Buildings, 2 per cent on $34,573	691
Boilers and auxiliaries, 5 per cent on $34,661	1,733
Engines, generators, etc., 4 per cent on $74,800	2,992
Annual cost of operation and depreciation	$32,648

DISTRIBUTING SUBSTATION AT MINNEAPOLIS.

The Minneapolis General Electric Company is erecting attractive transformer substations, of the type shown in the accompanying illustration, in outlying districts of the city, for reducing its 13,200-volt intramural transmission potential to the distribution pressure, 2300 volts. The substation shown is that recently completed at the corner of Garfield Avenue and Thirty-third Street and was designed for containing two 500-kw banks of step-down transformers, one of which is already installed.

The building is of brown pressed brick trimmed with Bedford limestone and measures 40 ft. x 28 ft. The gravel roof

Transforming Substation of Minneapolis General Electric Company.

is carried by steel beams. Along the sidewalls of the first floor provision is made for the two banks of oil-insulated, water-cooled transformers, stepping down to the 2300-volt busbars, from which three single-phase lighting feeders, one three-phase motor feeder and four magnetite-arc rectifier outfits are served. On the second floor, over the transformers, are two 50-lamp and two 100-lamp rectifier sets for the metallic-flame arcs, while facing the gallery hatchway, through which the stairway ascends, is the switchboard, with lever and bell-crank control of the oil switches mounted behind it and on the floor below. Along the rear wall are installed the automatic induction feeder regulators, whose relays are compensated to keep the voltage constant at the ends of the lines they feed. The 13,000-volt lead-covered transmission cable connecting the main downtown station with the Garfield Avenue substation is carried part of the way under ground and the remainder of the distance, more than a mile, overhead, hung from a steel messenger cable.

The new substation was designed by the engineering department of the Minneapolis General Electric Company, of which Mr. C. H. Harris is chief engineer.

HOW HYDROELECTRIC ENERGY DISPLACES COAL.

By Alton D. Adams.

Success of great hydroelectric systems depends in large part on the extent to which they are able to displace coal.

A number of the important conditions under which the energy of falling water is being substituted for coal are indicated below.

Hydroelectric supply in bulk goes to public-service corporations and to private plants and the number of consumers, average power and rates for each of these classes have much bearing on the results. The accompanying table of consumers on hydroelectric systems shows the number of public-service corporations and private plants supplied with energy and their average loads in various instances:

TABLE I—CONSUMERS ON HYDROELECTRIC SYSTEMS.

Number of Public Service Corp.	Number of Private Plants.	Transformer Rating per Consumer in Kw.	Average Kw per Public Service Corp.	Average Kw per Private Plant.	Kw-Hours in Year per Private Plant.
6	26	..	744	1,336	12,380,183
2	370	..	5,338	17	152,047
18	13	1,213	478	229	2,011,093
19	72	458	..	..	.....
4	10	1,140	..	..	.....
*9	..	..	682	..	.....

*Includes private plants.

Four of these hydroelectric systems supply energy over large areas, but the one with a total of 372 consumers is confined to a single city, which accounts in part for the number of private plants served. In only one instance is the number of private plants less than the number of public-service corporations using the hydroelectric energy.

The 72 private consumers shown on one system are all cotton mills, and this system supplies energy also to an unknown number of private plants in other lines of work.

Among the public-service plants supplied with energy by these hydroelectric systems are those distributing energy for lamps, motors, electric railways and sections of steam roads electrically operated.

For each of three hydroelectric systems the approximate average rating of substation or service transformers per consumer runs from 458 kw for the public-service and cotton mill load in the South to 1213 kw for the more even mixture of public-service plants and factories in the North.

Each of three hydroelectric systems has the average load in kilowatts of its public-service plants and also of its private consumers determined. This average is found by the division of the total kw-hours sold to each group of consumers during the year by the number of consumers in that group and by 8760, the total hours per year. For two of the three hydroelectric systems the public-service plants furnish the greater average load, and the exceptional average of 5338 kw is for one electric lighting company and one electric railway company in a great city.

The average load of 1336 kw is probably greater than can be found for as many as 26 private consumers on any other hydroelectric system. This load results from the extensive use of energy in the electrochemical industry. A great variety of manufacturing plants and some mercantile buildings go to make up the average load of 17 kw for 370 private plants in or near a single city.

Another view of the loads of private consumers on these hydroelectric systems is obtained by the statement of the average kw-hours per year for consumers of this class. Leaving out the system with the great electrochemical load, the other two show 152,000 kw-hours and 2,000,000 kw-hours per private consumer on an average respectively. These figures for average loads and energy consumption among private consumers on hydroelectric systems have additional interest because of the government regulation of such service in Massachusetts at points where hydroelectric systems are permitted to compete with central stations. In some cities and towns of this State the hydroelectric company may not sell energy to a private consumer "in a quantity less than 100 hp at any time," as provided by a special statute.

Under another special act and under orders of the Gas and Electric Light Commissioners of Massachusetts the hydroelectric company may not sell energy to any private consumer "whose motors and apparatus connected for use shall be of an aggregate rating of less than 300 electrical hp and whose annual consumption shall be less than 450,000 hp-hours."

As 300 hp corresponds to 225 kw and 450,000 hp-hours to 337,500 kw-hours the regulations in Massachusetts fall between the figures for the loads of hydroelectric systems in the service of private consumers elsewhere. The 337,500 kw-hours amount to an average load of 38.4 kw during 8760 hours.

For two of the above hydroelectric systems the kw-hours sold to public-service corporations and to private plants respectively in each of two successive years are given in Table II, as are also the average rates per kw-hour, and the corresponding figures of two other systems are given for one year. From 1908 to 1909 the two systems show an increase of output to both public and private consumers and also a reduction of average rates, except that only the sales to railways are included under the heading of public service for one system in the latter year and the railway rate is higher than that to all public service.

TABLE II—MILLION KW-HOURS SOLD AND AVERAGE RATES.

Number Consumers on Hydroelectric System.	Year.	Million Kw-Hours to Public Service Corp.	Average Cost per Kw-Hour to P. S. Corp. Cents.	Million Kw-Hours to Private Plants.	Average cost per Kw-Hour to Private Plants. Cents.
32	1908	40	0.38	321	0.26
29	1909	(*16)	(*0.41)	422	0.24
31	1908	71	0.58	26	0.58 approx.
33	1909	108	0.57	50	0.45
372	1908	93	0.61	56	0.84
9	1908	34	0.83	19	0.67

*Sales to railways only.

For the six years of operation representing two hydroelectric systems during two years and two other systems in one year the average rates to public-service corporations ran from 0.38 cent to 0.83 cent per kw-hour, while the averages to private plants were 0.24 to 0.84 cent per kw-hour. In only one instance was the average rate to private plants greater than that to public-service corporations, and in this case two of the corporations took 93,000,000 kw-hours, while 370 private plants used only 56,000,000 kw-hours. For two of the hydroelectric systems representing three years of operation the average load per private plant was less than the average per public corporation.

Whatever the reasons assigned for the fact the above figures go to show that large private plants secure lower rates from hydroelectric systems than do public-service corporations.

Further light on the conditions that regulate rates for hydroelectric service is given by Table III, showing sales to public-service corporations:

These sixteen companies are supplied with energy by a single hydroelectric system that transmits over a maximum distance of more than 150 miles from the hydroelectric station. The supply of water power is constantly available and the hydroelectric system uses no steam power.

Sales are made to electric lighting and motor service and to railway companies, and these sales range from 234,300 kw-hours to 20,391,176 kw-hours per year to the respective plants. The rates per kw-hour for the several companies range from 0.30 cent to 1.44 cents, but there is no regular increase of rates with decrease of consumption. Thus the railway that used 20,300,000 kw-hours paid a rate of 0.53 cent, while the railway

that used 1,000,000 kw-hours got it for 0.58 cent per kw-hour. So also one electric lighting company paid a rate of 0.31 cent for 9,200,000 kw-hours and another paid a rate of 0.70 cent for 8,100,000.

TABLE III—KILOWATT HOURS SOLD AND AVERAGE RATES, 1908.

Kind of Public Service Corporation.	Kw-Hours Sold.	Average Cost per Kw-Hour. Cents.
Railway	20,391,176	0.53
Electric light	9,217,888	0.31
Railway	8,243,018	0.597
Electric light	8,134,844	0.70
Railway	5,495,346	0.597
Motor load	5,292,016	0.30
Electric light	3,036,183	0.77
Electric light	2,911,000	1.00
Railway	2,344,792	0.69
Railway	1,442,466	1.15
Railway	1,088,057	0.588
Electric light	988,995	0.71
Railway	936,654	0.84
Railway	741,247	0.96
Railway	628,320	0.99
Railway	234,300	1.44

As far as known the sixteen railway and lighting companies were not under the same financial control as the hydroelectric system so that the rates paid represent the competition of the transmitted energy with production in local plants.

Some factors that bear on this competition are the cost of coal and the use of local water power. In the strip of territory about 150 miles long where this hydroelectric energy is transmitted and sold the price of boiler coal runs from $2.25 to $3.00 per long ton, the lower prices applying in places nearer the generating station. The sale of 20,300,000 kw-hours at the rate of 0.53 cent was made to a railway in a city where boiler coal costs about $3.00 per ton, after the energy had been transmitted fully 150 miles. In this same city the lighting company purchased 8,100,000 kw-hours of the transmitted energy at the rate of 0.70 cent.

A railway and lighting company in a city about eighty miles from the hydroelectric plant paid a rate of 0.597 cent for 8,200,000 kw-hours of the transmitted energy, and this company also used a variable local water power as well as a steam plant. The railway that used 1,000,000 kw-hours at the rate of 0.588 cent starts at a point about 20 miles and ends 80 miles from the hydroelectric plant. The lowest among the rates to lighting companies was that of 0.31 cent for 9,200,000 kw-hours at a point about twenty miles from the hydroelectric station, where the price of boiler coal was less than $3 per ton. The electric light company that purchased this 9,200,000 kw-hours owns steam engines of 550 hp and water wheels of some 600 hp rating.

Incomes of hydroelectric systems are large per consumer and small per kw of load, as shown in Table IV of loads, consumers and incomes. Each load and income represents a recent year of operation for one system.

TABLE IV—HYDROELECTRIC INCOMES.

Kw Load.	Kind of Load.	Number of Consumers.	Income per Consumer.	Income per Kw Load.
18,800	Sta. maximum	9	$46,459	$22.2
30,705	Not stated	54	5,785	10.1
37,620	Transformers	31	18,624	15.3
41,750	Transformers	91	9,003	19.6
50,700	Transformers	33	25,474	16.5
55,869	Connected	372	2,837	18.8
60,660	Connected	32	31,525	16.6

The load stated represents the maximum at the generating station for one system, the transformers on transmission lines in three other instances, and in one case the nature of the load is uncertain, but it may be the rating of the connected apparatus. The other two figures are for connected loads.

Loads vary from 18,800 to 60,660 kw per system and the corresponding numbers of consumers from 9 to 372. The largest annual income per consumer is $46,459 and the least is $2,837. Per kw of load the largest income is $22.2 and the least is $10.1 annually.

Lighting and railway plants and motors in factories made up most of the load of 18,800 kw among nine consumers. Electrochemical furnaces to a greater extent than motors gave 54 consumers a load of 30,705 kw.

The transformer loads of 37,620 kw and 50,700 kw respectively were connected to the same hydroelectric system in successive years, and this power was used by lighting and railway companies and for mechanical purposes.

A unique feature of the transformer load of 41,750 kw among 91 consumers was that 72 of the consumers were cotton mills with an aggregate rated load of more than 30,000 hp. The income per consumer and per kw of load on this hydroelectric system was probably lower than the $9,003 and the $19.6 given in the table, because the 41,750 kw of transformers was connected in the year previous to that for which the income is given and meantime the rating of transformers in service no doubt increased. For this same system the stated number of 91 consumers is incomplete and applies a year earlier than the income figures.

While the connected load of 55,869 kw was operated for 370 comparatively small lighting and motor-service consumers in a city and for a lighting and a railway company, the load of 60,660 kw was made up largely of electrochemical furnaces and was operated for 32 consumers.

PURIFICATION TREATMENT OF TRANSFORMER-COOLING WATER MADE NECESSARY BY SCALE IN COILS.

Artesian-well water is used for cooling purposes at Substation A of the Minneapolis General Electric Company, where 15,000 kw of water-cooled, oil-insulated transformers are installed for stepping down from the 50,000-volt transmission potential of the Taylor's Falls line to the 13,200-volt pressure employed within the city limits. For a year or more trouble was noticed from excessive temperature rise in some of these transformers, but the true cause of the difficulty was not discovered until it was observed that the cooling coils seemed to be clogged and would not allow their rated quantities of water to pass. On examining these coils they were found to be lined with a thick coating of hard, flinty deposit from the well water which could be chipped only with difficulty. This material had incrusted the tubing with a solid, stony lining almost closing the orifice and preventing the transfer of heat from the transformer to the small stream of water that found its way through the coil.

A number of methods were tried for removing this deposit from the coils, and at last a 10 per cent solution of acetic acid was successfully employed, attacking the scale and dislodging it effectively. This acetic-acid solution was run through the coil and into a large tub, to the bottom of which the entrained scale was precipitated, so that the clear acid solution could again be drawn off and used from the top of the tub. After the transformer-cooling coils were again restored to serviceable condition analysis was made of the water and a purification plant was ordered capable of treating 1000 gal. daily. The artesian-well water showed a total of 49 parts of solids to 100,000, the ingredient proportions being as follows by parts: Calcium carbonate, 20.25; magnesium carbonate, 12.6; sodium chloride, 6.9; calcium sulphate, 3.4; silica, 2.16; iron and aluminum oxides, 0.18. The transformer-cooling water will be used over again and again after passing through a cooling tower, as before, while, as necessary, make-up water to take the place of that lost by evaporation will be added from the treated-water tank of the purifier outfit. The formation of scale in transformer-cooling coils is unusual and the installation of water-treating apparatus to relieve this condition is thought to be the first of the kind ever made necessary for this purpose.

ELECTRIC DRIVE IN A WATER FILTRATION PLANT.

An interesting use of electric motors is made in the filtration plant of the municipal water system of Wilmington, Del. In filtration plants one of the chief considerations is the cleaning of the sand used in the filter. This is accomplished at Wilmington by the use of the Blaisdell filter-sand washing machine. In this machine an inverted open box is sunk under the water of the filter to the sand surface and is held in position and operated electrically from a crane platform. The whole machine runs on rails the whole length of the filter over the water which is being filtered, which in turn is superimposed on the sand of the filter. A transfer table enables the machine to be shifted from one set of rails to another so that the whole area of the filter may be covered.

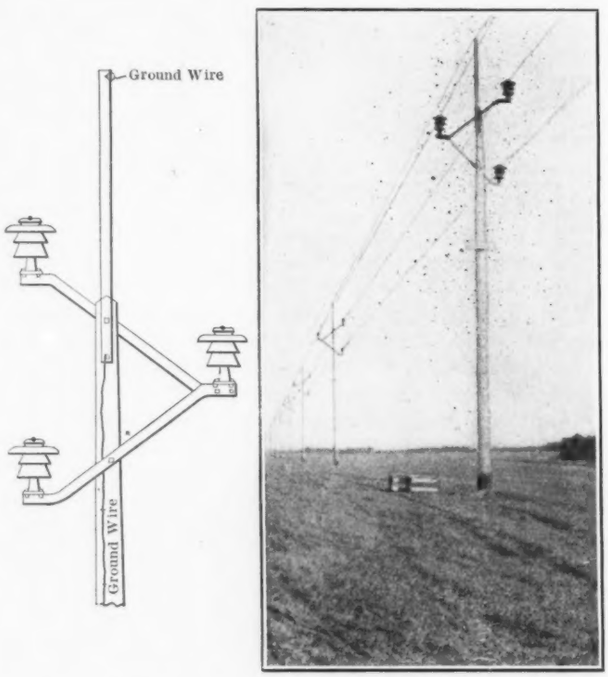
The box contains a revolving hollow axle terminating in a hollow head resting on the sand. From this head hollow fingers or stirrers extend down into the sand. As the axle and head revolve, stirring the sand by means of the fingers, clean water under pressure is forced through them and passes into the sand through small holes in the fingers. A suction pump draws away the dirty water, taking away just a little more water than is supplied by the pressure pump. In this way all the dirt which has been stirred and washed from the sand is discharged into a sewer. A little water comes into the box under its edges, through the sand, and as the suction is a little stronger than the water pressure applied none of the dirty water escapes from the box into the filter. While the operation is proceeding the whole machine moves slowly ahead over the sand, and, as stated, it is adapted to reach every portion of the filtration bed.

Electrical energy is conveyed to the machine by an overhead double trolley. Six 220-volt direct-current motors are employed, as follows: Side travel, 7.5 hp; chamber hoist (used in lifting and lowering the box), 7.5 hp; stirrer-wheel spindles, 20 hp; crane travel, 20 hp; discharge pump, 10 hp; pressure pump, 25 hp. All of these are variable-speed reversible machines, except that the discharge-pump motor is non-reversible and the motor for the spindles or fingers is constant-speed and non-reversible. A switchboard, provided with a controller for each motor, is mounted on the machine at the operator's position. The main switch is designed to carry 300 amp at 220 volts and is provided with no-load and overload release. The motors installed are purposely of large size to prevent heating in the confined locations in which they are placed. The total amount of energy required to operate the machine under normal conditions is from 20 hp to 45 hp. The longitudinal speed of travel of the machine is from 2 ft. to 12 ft. a minute and the filter sand may be stirred up to a depth of 24 in. The amount of wash water required is from 120,000 gal. to 180,000 gal. per acre of filtration bed.

NEW CROSS-ARM CONSTRUCTION FOR TRANSMISSION POLES.

A cross-arm construction which avoids the use of braces or gains, reduces the required height of poles, number of bolts, tree trimming, etc., and is within itself braced and balanced for vertical and longitudinal stresses, has been employed in building the 60,000-volt transmission line of the Northern States Power Company, to connect Cannon Falls with Mankato, Minn. Two sections of the line, from Cannon Falls to Faribault and from Mankato to Rapidan, are already completed and will be placed in service when the new water-power developments now under construction at these points begin operation. The improved type of cross-arm was designed by the engineers of the H. M. Byllesby Company, and upon its features of novelty a United States patent has recently been granted.

As shown by the accompanying illustrations, the "wishbone" arrangement of the cross-arms consists of two steel angle-sections, bent and bolted together, making an angle of 60 deg. between legs. The ends of the arms are bent into horizontal position, and to the flat web surfaces at these points the cast insulator pins are bolted. The arms are bolted to the pole at points two-thirds of the distance from the crotch or single-wire side. The moment of the single wire with its long arm thus balances the moment of the two wires at their short arms,



Cross-Arm Construction on Cannon Falls (Northfield, Minn.) 60,000-Volt Transmission Line.

nullifying any tendency to rotation about the pole due to unequal span lengths. Such rotation is also braced against by the interlinked mounting of the cross-arm pieces, one shank passing on one side and the other on the opposite side of the pole. The top cross-arm is mounted squarely transverse to the line of transmission, while the lower arm receives a slight lateral bend, sufficient to allow it to pass on the other side of the pole, so that when in position its horizontal projection makes a small but hardly noticeable angle with that of the upper arm. The resulting bracing action secures the arms against rotation caused by unequal span stresses, a provision practically impossible with other single-arm constructions. The "wishbone" arms are also mutually braced, as levers of the third class, against vertical stresses due to the weight of the wires, without employing the brace pieces ordinarily used.

Only two bolts are required to assemble the arms, and two through bolts are needed to attach them to the pole. Under the nut of the bolt holding the upper arm a vertical angle ground-wire support is clamped, being held rigid by another through-bolt transfixing the pole just below. The steel work is bolted to the pole without cutting gains for its reception.

In the 60,000-volt line referred to the delta distance between wires is 6 ft., but the horizontal width of the transmission triangle is only 4.8 ft., reducing the amount of clearance required by the old type of horizontal-arm construction. When erected along roadways the arms are mounted with the single-wire or longer side toward the road, reducing the necessity for cutting foliage bordering the highway. With this "wishbone" type of construction the poles used may be shorter than before, since the inclined arm carries the topmost wire several inches above the peak of the pole.

SOME NOTES ON GROUND CONNECTIONS.

BY EDGAR H. HOLMES.

The writer does not intend what follows to be a systematic discussion, but merely a record of some methods of making ground connections and of some performance data. Much of the information has been taken from the writer's notebook, the rest has been acquired through conversation with and by reading the reports of operating and erection men.

It is quite well established that it is of the greatest importance that ground connections be well made. It has been the experience of men that have investigated lightning arrester troubles that many are caused by imperfect earth connections.

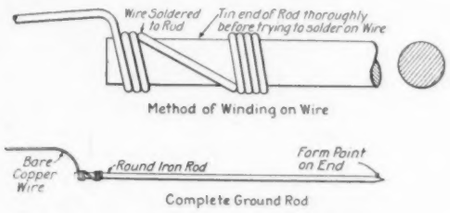

Wire Soldered to Rod
Tin end of Rod thoroughly before trying to solder on Wire
Method of Winding on Wire
Bare Copper Wire
Round Iron Rod
Form Point on End
Complete Ground Rod

Fig. 1—Wrought-Iron Ground Rod.

The best arrester equipment purchasable may be installed, but if the earth connection is not good the arrester cannot be expected to do its work properly. The cost of the earth connection is usually but a fraction of that of the arrester. Money spent in arranging a good earth connection is very well spent and it is just as important that a lightning arrester have a good ground as it is that the arrester itself be good.

In Fig. 1 is illustrated a good method of constructing a ground rod. It is one that has been used by telephone and electric lighting companies to a considerable extent. The rod is of commercial rolled iron, and a diameter of ½ in. or ⅝ in. is usually chosen. Wrought-iron pipe, either plain or galvanized, can be used instead of iron rod. A length of copper wire is soldered to the upper end of the rod, as indicated in Fig. 1, and the lower end is pointed. Such a rod should be from 5 ft. to 7 ft. long. It will be found most economical to solder the lengths of wire to the rods at the station, where the proper appliances usually are available. At best, it is not easy to solder to iron, so that for satisfactory results the operation should be performed under favorable conditions.

In soldering, the upper end of the rod should first be filed until it is quite clean and bright. All traces of scale and oil must be removed. Then it must be heated in the flame of a blow-torch until solder will melt when applied to it. The hot end should now be rubbed in a pile of powdered sal-ammoniac, which will clean it chemically, and solder wire applied simultaneously. The end will "take" the solder readily and soon become "tinned." The end of the length of copper wire can now, after being well cleaned with sandpaper, be wound around the tinned portion in the manner indicated in Fig. 1 and solder again applied. Solder will flow over the wire and effect a good electrical connection between it and the pipe or rod. The completed joint can be cooled quickly with a piece of wet waste.

Ground rods are installed by merely driving them into the earth. The ground wire from the lightning arrester or other device to be grounded is connected and well soldered to the

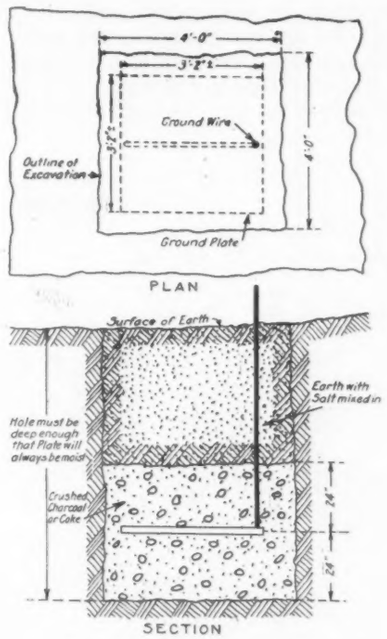


Fig. 4—Copper-Plate Ground.

length of copper attached to the ground rod. There is never much difficulty in soldering two pieces of copper wire together. When a ground rod is being driven the blows from the driving hammer tend to make it vibrate transversely. The effect of such vibrations is to push the earth away from the rod and to make the connection between them poor. Therefore, after driving it, the earth around a ground rod should be well tamped.

In the following table are shown some ground-rod resistance values—the resistance in ohms between driven ground rods and a town water-pipe system—which indicate the effect of thorough tamping.

Resistance Before Tamping.	Resistance After Tamping.
1600 ohms.	59 ohms.
1800 ohms.	83 ohms.
1550 ohms.	72 ohms.
1950 ohms.	90 ohms.

These results are from some tests made on Long Island, New York. The formation was about 2 ft. of dark soil above a thick layer of sandy gravel. These resistance values, even after the ground had been tamped, are rather high. A good rod or pipe ground should, under favorable conditions, have not more than from 15 ohms to 30 ohms resistance.

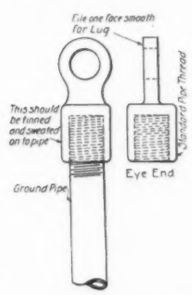


Fig. 2—Commercial "Eye-End" on Pipe.

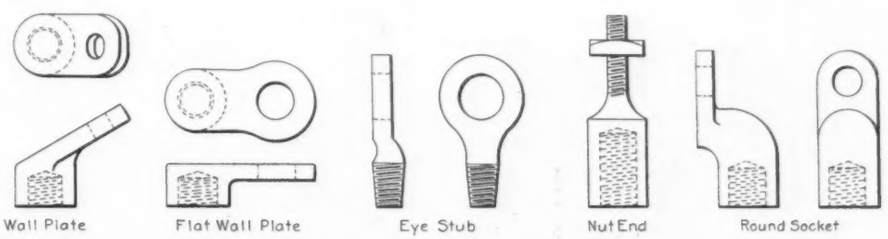


Fig. 3—Forms of Commercial Awning Fittings.

In Fig. 2 is illustrated a method of providing a pipe-ground rod with a terminal. The terminal is a commercial awning pipe fitting known as an "eye-end." This fitting is made in all standard pipe sizes from ¼ in. to 1 in., inclusive, and is tapped with a standard pipe thread. This arrangement is convenient where it is desirable to disconnect the ground lead from the pipe so that the ground can be tested. A terminal lug should be soldered to the end of the ground lead. The lug is tightly bolted to the "eye-end." Then tinfoil is wrapped about the connection to exclude moisture and the whole thoroughly taped. A bolted connection, made as suggested, will remain in excellent condition for a surprisingly long time. It should, however, be inspected when the ground is tested. It is necessary to disconnect the lead from a ground pipe to test the ground resistance when the pipe forms one of a group, such as is used in a multiple-pipe ground. A diagram of a multiple-pipe ground is shown in Fig. 15.

Other forms of awning fittings that sometimes can be utilized in arranging pipe grounds are shown in Fig. 3. All of these can be obtained in either black or galvanized finish, and all have standard pipe threads. The commercial name by which each fitting is known is given under it in the engraving.

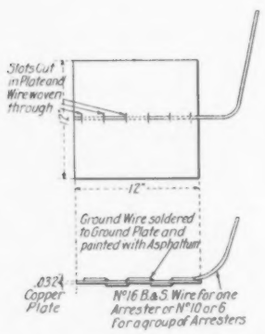

Slots Cut in Plate and Wire woven through
12"
Ground Wire soldered to Ground Plate and painted with Asphaltum
.032" Copper Plate
No 16 B & S. Wire for one Arrester or No 10 or 6 for a group of Arresters

Fig. 5—A Copper Ground Plate.

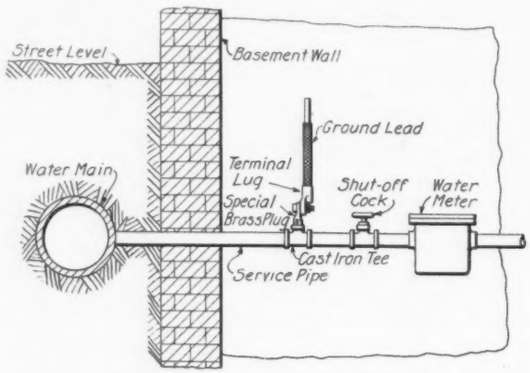


Fig. 6—Ground on a Water Pipe.

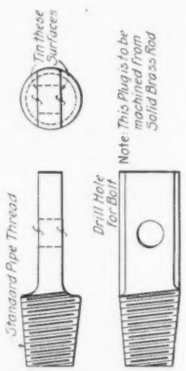


Fig. 7—Brass Ground Plug.

Telephone central-office grounds must be good ones. As a rule, a connection is made to both gas and water pipes when the two are available. Fig. 6 shows the method of effecting a connection with a water pipe that has been used by some of the largest telephone companies. A special brass plug (see Fig. 7 for details) is turned into a tee in the pipe system and a terminal lug on the end of the ground lead is sweated and bolted to it. Such a connection is always made on the street side of the shut-off cock and of the meter so that the removal of either of these members cannot affect the continuity of the ground connection. Sometimes a connection to a water pipe is made by soldering a copper strap around the pipe and then connecting the ground lead to the strap. It is extremely difficult and not always altogether safe to solder to a pipe that is full of water.

Another form of ground that has been used by some of the big telephone companies is detailed in Figs. 8 and 9. A ground of this type is sometimes arranged under the basement floor of a central office, as shown in Fig. 8. This procedure appears to be satisfactory where there is every assurance that the earth surrounding the copper-ground spiral will always be moist. The writer has been given to understand that, even when this type of ground is installed out of doors, a layer of concrete 1 ft. in thickness is placed at the surface over the spiral to maintain the ground lead in position and to prevent any tampering

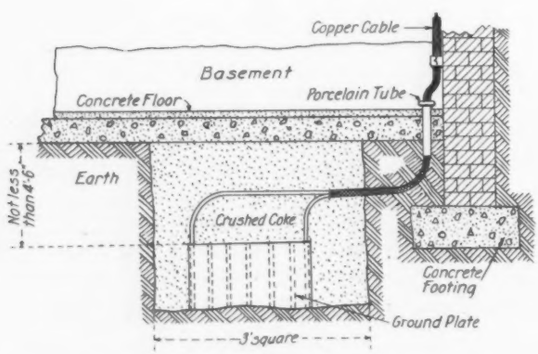


Fig. 8—Ground Made with a Copper Spiral.

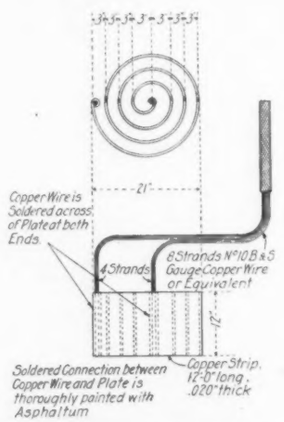

21"
Copper Wire is Soldered across of Plate at both Ends.
4 Strands
8 Strands No 10 B & S Gauge Copper Wire or Equivalent
12"
Soldered Connection between Copper Wire and Plate is thoroughly painted with Asphaltum
Copper Strip, 12'-0" long, .020" thick

Fig. 9—Details of Copper Spiral.

In Fig. 4 is indicated the method of preparing a station ground for lightning arresters as recommended by one of the large electrical manufacturing companies. The ground plate is of sheet copper, tinned, and should be about 1/32 in. thick. The ground wire, which should be equal in conductivity at least to No. 0 B. & S. gage wire, is soldered on the entire width of the plate. An old iron casting having a superficial area at least equal to that of the copper plate can be used if copper is not available. For a terminal a copper strap can be riveted to the plate. It is recommended that when the hole is being filled in plenty of water be used for settling the earth.

A great many grounds are made by the telephone companies for the telephone-station lightning arresters. Where possible a

with the lead or with the copper spiral, which is shown in Fig. 9.

Common salt mixed with the earth surrounding a ground pipe or plate decreases the resistance of the ground considerably below that of a similar but unsalted one. The curve reproduced in Fig. 10 brings out this fact. The ground from

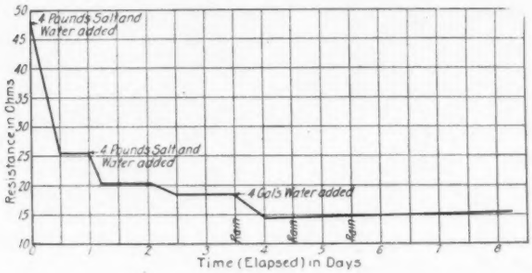


Fig. 10—Curve Showing Effect of "Salting."

which the values plotted were obtained was made by driving a pipe 5 ft. into the earth. At the surface the soil was scooped out around the pipe. In this cup-shaped depression 4 lb. of salt

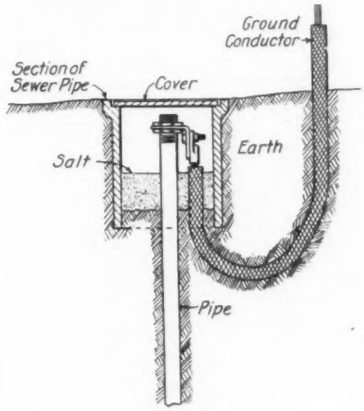


Fig. 11— A "Salted" Pipe Ground Unit.

was dumped. Salt and water were subsequently added as indicated on the curve. It will be noted that the original resistance of the unsalted ground was about 48 ohms, but that it

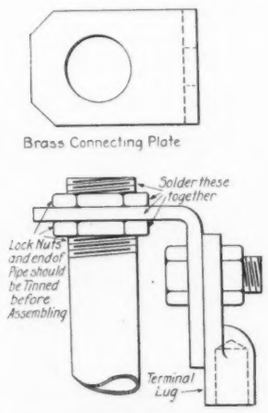

Brass Connecting Plate
Solder these together
Lock Nuts and end of Pipe should be Tinned before Assembling
Terminal Lug

Fig. 12—One Method of Connecting to Ground Pipe.

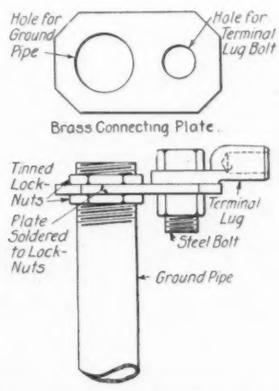


Fig. 13—Another Method of Connection.

was reduced by the addition of salt and water to something less than 15 ohms. As the salt is washed out of the surrounding soil by rain the resistance of the ground will gradually increase.

To take advantage of the property of salt in decreasing ground resistance a form of pipe-ground unit similar to that shown in Fig. 11 has been suggested. A ground pipe having a nominal diameter of about 1 in. is driven into the earth a distance of about 6 ft. and a length of sewer pipe arranged around its top, as shown in Fig. 11. A wooden cover fits in the shoulder on the sewer pipe. The ground lead is connected to the pipe by means of the arrangement illustrated in Fig. 12. This permits of the lead being readily disconnected so that the ground may be tested. A supply of salt, which will soak into and saturate the surrounding earth, is maintained in the sewer-pipe chamber. Where the ground lead is not of heavy wire and can be easily bent, a simple connecting arrangement, outlined in Fig. 13, can be used. It can also be used where the

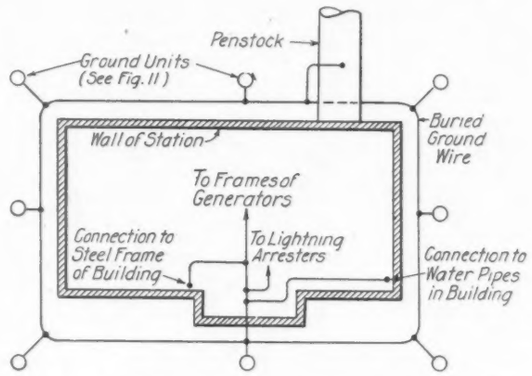


Fig. 14—Ground Units Around a Generating Station.

ground lead leaves the pipe in a horizontal direction instead of in a vertical one, as in Fig. 11.

It was suggested above that the ground pipe should be driven to a depth of about 6 ft. Experiments show that little is to be gained by exceeding this depth. The resistance of a pipe ground does *not* vary inversely as the depth in a simple ratio. For the first few feet driven the resistance decreases rapidly for each additional foot of depth, but as the depth increases the resistance decrease is less rapid. The resistance is almost constant for depths greater than 7 ft. or 8 ft.

At present the practice of making multiple-pipe grounds is largely followed. A multiple-pipe ground (Fig. 15) consists of a number of pipe-ground units, similar possibly to that of Fig. 11, connected in parallel. The resistance of such a group is considerably less than that of any single unit in it. In arranging ground units one should be located as near as possible to the lightning arrester and the others grouped, as in Fig. 14, around the building. Auxiliary ground leads should be con-

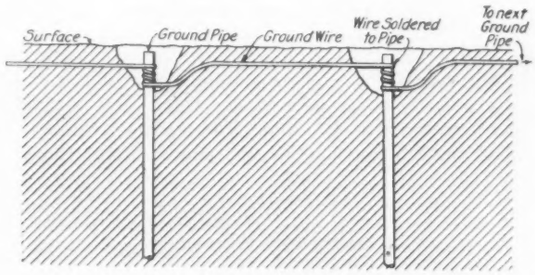


Fig. 15—One Method of Making Multiple-Pipe Ground Connection.

nected to the metal frame of the building, to any available water and gas pipes and to the penstock or pipe line if the plant is operated by water-power. Ground connections are also made to the frames and cases of apparatus to be protected.

A method of connecting multiple-pipe grounds together less elaborate than that illustrated in Figs. 12 and 13 is shown in Fig. 15. In this simple method the ends of the ground pipes are tinned, as described in connection with Fig. 1, before they are driven. After driving the bare copper ground wire that is to connect the pipe ends together is wrapped around each pipe in succession and soldered thereto.

LETTERS ON PRACTICAL SUBJECTS

EMERGENCY STRAIN INSULATORS MADE FROM GLASS INSULATORS.

A strain insulator that gives entirely satisfactory service when used with ordinary good judgment can be made as indicated in Fig. 1 by knocking the end out of a commercial glass insulator. Obviously a strain insulator made in this way is not as good either mechanically or electrically as many standard types that are readily obtainable. It is recommended only for emergency or temporary installations. Some applications are shown in Figs. 2 to 7.

Any heavy tool having a portion of suitable diameter and long enough to enter and reach the bottom of the glass insulator may be used for altering the insulator instead of the screwdriver shown in Fig. 1. The insulator to be altered is held with the left hand and with the tool a sharp downward blow is given into the threaded cavity of the insulator and against the

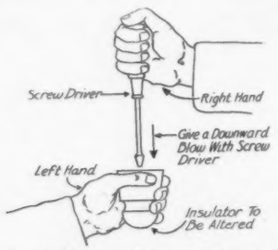


Fig. 1—Method of Altering Insulator.

bottom. Occasionally the insulator will break into many pieces and be lost, but usually only its top is cracked off on a reasonably regular plane. Linemen use their connectors or their pliers in altering insulators. The blow is given with one of the legs or sides of either of the tools.

Fig. 2 shows one of the many methods of making up the

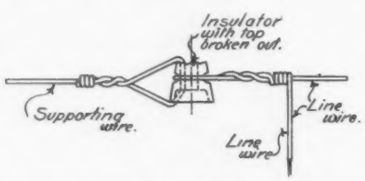


Fig. 2—Altered Insulator in Use.

wires about an altered glass insulator. In the illustration the line wire is shown in the groove and the supporting or pull-over wire is shown threading through the hole. This arrangement need not necessarily be followed. The relative locations of the two wires are often made the opposite of those shown. In

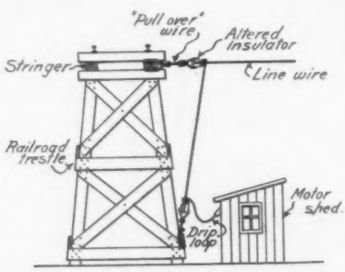


Fig. 3—Line Wiring for a Motor.

Fig. 3 an application is shown of the combination detailed in Fig. 2. A motor had been installed for a contractor's plant in a shed (Fig. 3) which was close to a railway trestle. It was imperative that the motor should be connected immediately to conductors on a pole line a short distance, possibly 150 ft., away. Wire and insulators were available, but no other electrical material and it was desirable so to make the installation that it would be reliable and capable of operating for several months.

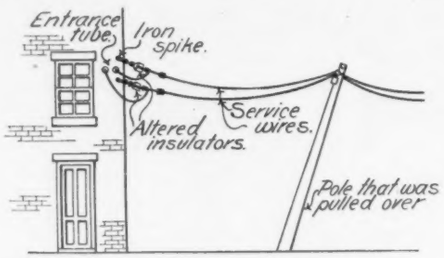


Fig. 4—An Emergency Application of Altered Insulator.

The outside wiring was insulated and supported with altered insulators as suggested in Fig. 3.

Another emergency application is shown in Fig. 4. In this case altered insulators were used to restore electric lighting service

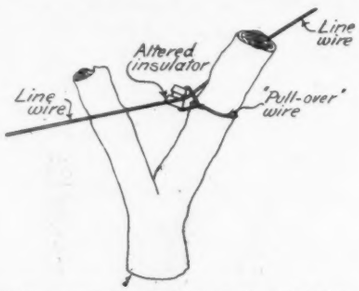


Fig. 5—An Improvised Tree Insulator.

to a building. When the electric lighting company's emergency man arrived at the building he found that the pole from which the service wires to the building were taken had been pulled partially over through the breaking of a guy wire, that the

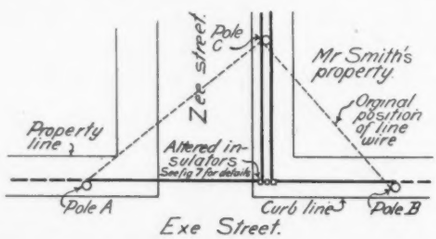


Fig. 6—The Solution of a Right-of-Way Difficulty.

service wires had been broken, and that the iron brackets and the wooden cleat which supported them had been pulled down. It was impossible to replace the cleat and bracket with the tools the man had and he could not pull the pole back into normal position, so he restored service temporarily by driving spikes at the corner of the building and supporting the service wires on the spikes with altered insulators. (See Fig. 4.)

Altered insulators can be used for tree insulators as suggested in Fig. 5. Where a line wire is in contact with the limb or branch of a tree it is usually possible to eliminate the con-

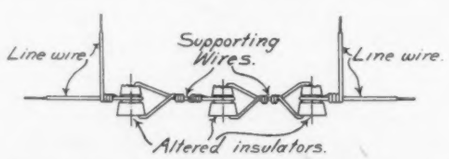


Fig. 7—Plan View of Insulator Arrangement.

tact by placing the line wire in the groove of an altered insulator and pulling and tying it away from the offending member with a pull-over wire. (See Fig. 5.) The line wire is sometimes tied in the groove of the insulator, but, as a rule, this is not desirable because if the line wire is tied the swaying of the

tree may break the conductor. Tree insulators especially formed from glass or porcelain are made and are preferable for permanent work to the altered type of Fig. 5.

A right-of-way difficulty was solved with altered insulators in the instance pictured in Fig. 6. Wires of a series circuit spanned, as shown by dotted lines, from poles *A* and *B* to pole *C* and one of them crossed property. To the presence of this wire the owner objected and insisted that it be removed. The heavy lines show how the wires were rearranged to meet the property owner's demands without setting a pole. Fig. 7 shows in detail the arrangement used and wiring of the altered insulators. The wiring was made up on the ground, after careful measurements had been taken, and was then raised to its aerial position before the original wires, shown by dotted lines, were removed. The new work was then spliced to the portion of the old that was to remain and the useless part of the old installation was cut down.

Swissvale, Pa. HARRY L. BEARDSLEY.

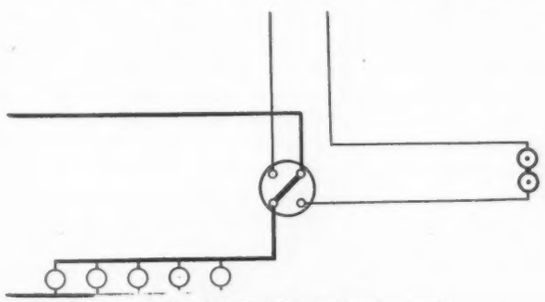
A WATERPROOF MACHINERY FOUNDATION.

Recently the necessity arose for making a waterproof foundation to sustain a steam engine and electrical generator and to serve as a retaining wall, also to carry a portion of the building in which the generating machinery was to be placed. Various methods of waterproofing were discussed, including the coating of the bottom and outside of the foundation with asphalt and tarred paper. Finally it was decided to attempt the construction of an impervious, monolithic concrete foundation. The building was located on inclined ground, in fact, about midway up a side hill, half a mile or so from top to bottom. The soil was gravel with clay underneath and rock underneath the clay. A stream of water coursed down the gravel strata on top of the clay during the greater portion of the year. For diverting this underground stream of water the waterproofing of the foundation became necessary. The footing of the foundation had to be placed in the clay about 15 ft. underground, hence there was no danger from frost. The excavation was made and rows of drain tile were placed underneath where the foundation was to be built. A ditch was dug around the entire up-hill side of the foundation and the down-hill slope of the ditch was inclined about 45 deg. to the level of the foundation footing. This side of the ditch was covered with cement mortar and troweled smooth, then three lines of drain tiling were laid in the ditch and covered with broken stone, coarse gravel, brickbats and any coarse material available which was free from sand or loam. A layer of cement mortar was spread over the clay underneath the drain tiling where the foundation was to be located. The tiles were then put in place, the rows being about 2 ft. apart and extending laterally along the side of the hill with drainage inclination of about 1/16 in. to the foot. The tiles were not pointed directly up and down the side hill, but laterally or crosswise, as stated before. A layer of coarse material was then placed on top of the drain tile; this material was similar to that in the ditch above mentioned and was from 8 in. to 12 in. thick. This material was well rammed with a maul having a head 12 in. square. It was made large for the purpose of driving the coarse material down rather than spreading it apart. Two men used the rammer. A 2-in. layer of concrete made from run-of-bank gravel was then spread over the broken stone and coarse gravel and the foundation proper was then placed upon the drainage foot above described. As the foundation was to be monolithic, the usual forms were built of wooden scantlings, plank and boards. The next step was to secure a concrete mixture which would be waterproof. The available material was glacial gravel which would assay about 50 per cent through the ¼-in. mesh, and the 50 per cent of tailings which would not pass the screen consisted of egg-shaped pebbles ranging from 6 in. downward, but containing a large proportion of stone 1 in. and 2 in. in diameter. The next problem was to secure sufficient material to do the work. The cubical contents of the foundation were carefully calculated and enough gravel screened out to give the cubic yards required by the foundation. No account was taken of the sand which passed the ¼-in. screen, but the needed quantity was secured from the large pebbles. A box 12 in. wide and 12 in. deep was nailed up watertight and fitted with a tight bottom. This box was filled with large pebbles as they came to hand, no attempt being made to select them or to avoid very large or very small ones. The pebbles were packed into the box by tamping slightly and when the box was full the water, previously weighed, was poured in. It was found that nearly 17½ lb. of water was required to fill the interstices of the gravel. The next step was to find material for filling these interstices as full as possible. Had it been possible to separate the pebbles into large and small sizes a more dense concrete might have been obtained, but that not being possible, the engineer cast about for material which would fill the voids in the gravel as full as possible. A quantity of roof gravel was at hand and he tried the experiment of mixing 28 per cent of that with 1 cu. ft. of the pebbles. He found, however, that the mixture would not go into the box, showing that the roof gravel could not fill all the voids which existed in the large material, but would increase the volume considerably. He succeeded in mixing in 15 per cent of roof gravel without increasing the volume. He then tried the experiment of mixing mortar sand with the pebbles and roof gravel. Thirteen per cent of the sand screened out originally was mixed in again, but the mixture would not all go into the box. A lot of fine sand was found near by which would pass a No. 20 sieve; 13 per cent of this sand was mixed in and it was found the cubic foot box would easily contain the 72 per cent of pebbles, 15 per cent of roof gravel and 13 per cent of No. 20 sand. Here was 100 per cent of material; the box was apparently full, but no cement was yet in the mixture. The engineer now commenced mixing dry cement with the box full of material and succeeded in placing therein between 12 per cent and 13 per cent of Portland cement and could still place the entire mixture in the cubical box. The foundation was built of this material, mixed as above, and from 8 per cent to 9 per cent of water was added, when the concrete was gaged. It may be added that the mixture thus experimented with was manipulated in the cubical box while that receptacle was placed on the platform scales so that the weight could be sent at any time. It was found that the resulting mixture was so dense that it weighed upward of 124 lb. to the cubic foot before any water was added. After curing it weighed about 160 lb. to the cubic foot, and no water of any consequence has ever found its way through the foundation or the retaining wall portion of the structure. It was a perfect success.

South Bend, Ind. JAMES F. HOBART.

AUTOMATIC CONNECTION OF EXTENSION BELL.

Recently the writer had occasion to make the following good use of a two-way switch when called in to install a telephone extension bell in a small factory building. It was desired to



Automatic Cut-Out for Extension Bell.

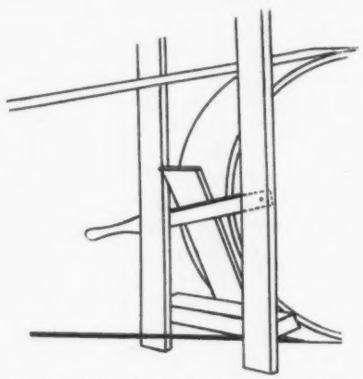
have the extension bell ring out in the shop when no one was in the office to answer it, but some means was also required for cutting off the bell when the office was occupied. The office was on the ground floor in a corner so dark that artificial light was needed all day. As it seemed safe to assume that the bookkeeper or his assistant would turn on the lamps

while they were in the office and switch them out of circuit when they left, both the lighting circuit and the bell circuit were connected through the two-way switch as shown, with the result that when the lamps were lighted the bell was out of circuit and when the lights were extinguished the bell was connected. Of course, the lamp and bell circuits are entirely independent and insulated from each other, and the arrangement has proved an entire success so far as the automatic disconnection of the bell is concerned.

Tallahassee, Fla. W. H. Johnson.

A SIMPLE WATER-WHEEL BRAKE FOR LEAKING HEADGATES.

The headgates of our water-wheel installation do not close so tightly but that there is sufficient leakage to keep the two 150-hp wheels turning over at a slow rate of speed when the generator is shut down. The station attendant has used various nondescript means which came to hand for stopping the wheels



A Simple Water-Wheel Pulley Brake.

under this condition, but found the most effective method was to apply a board as a brake against the face of the pulley. We have now arranged a permanent wooden brake, as shown in the accompanying sketch, which has proved very useful. The construction is crude but simple; the hand lever moving against the inclined guide forces the board against the pulley face with the multiplied advantage of the leverage obtained.

Detroit, Mich. Gallahad Jones.

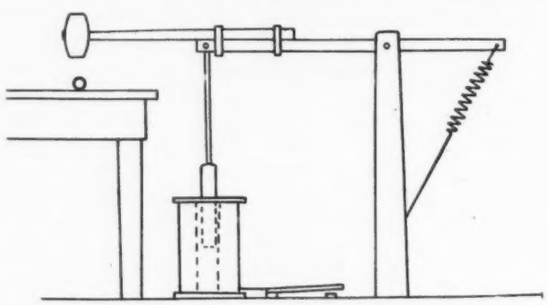
INCREASING THE OUTPUT OF A WATER-POWER INSTALLATION.

In a water-power plant installed four years ago a 3000-hp turbine was placed in service under an average head of 163 ft. The water contained fine silt held in suspension and in a few months it was found that the silt acted like the finest emery powder upon the gates and runners, so that the output of the wheel in less than four years was cut down to about 1100 hp. It recently became necessary to install a new wheel, and in spite of the comparatively low head it was decided to utilize the impulse type of prime mover in order to escape the deleterious action of the silt. The generator was designed in the original installation for 200 r.p.m., and in order to obtain the requisite power at such low head and low velocity it was necessary to make up the deficiency in the ideal diameter of the runners and use more runners than would be required in a normal installation. In the unit now in service the wheel is of the Pelton type with six runners on a shaft 32 ft. long, each runner being provided with water by two nozzles leading from a common header. The lower nozzle is plain and impinges the water in a horizontal direction, the other nozzle being set on top of the runner and pointed slightly backward, the regulation being accomplished by a needle valve. The governing is done by balanced deflectors, one of which deflects the stream from each nozzle. These deflectors are so designed that the deflector over the needle nozzle comes into action first and after the deflector is well into the stream the larger deflectors on the lower or horizontal nozzles come into action. The deflectors are governed by a Lombard water-wheel governor equipment. The load on the wheel is fluctuating, often varying from 400 kw to 1600 kw in thirty seconds or less, but at no time has the speed of the wheel varied more than 2.5 r.p.m. in each direction. On account of the great length and size of the wheel it was necessary to enlarge the building to accommodate it. A concrete casing was used to inclose the greater part of the wheel in place of steel, which made its operation less noisy and also lowered the cost of installation. The switchboard was raised to the level of the wheel top, making operation much more convenient in view of the frequent adjustment required to secure good efficiency during low-water periods.

Boston, Mass. K. S. Howard.

SOLENOID-OPERATED SLEDGEHAMMER FOR STRAIGHTENING PIPE.

A large Western manufacturing concern which uses large quantities of common iron pipe, 0.5 in. to 2 in. in diameter, has installed a number of solenoid-operated sledgehammers to straighten the pipe before utilizing it for structural purposes in its manufactured products. This process of straightening a piece of pipe was formerly carried out by two laborers, one to sight along the line of the pipe and turn it to bring the bends upward and the other to swing the sledge, striking the pipe on the flat table, under the direction of the first man. The second man has now been superseded by an electrical machine which does the work better and more accurately. As shown in the accompanying sketch, the "electrical Dago" (which is the local name for the device) comprises a pivotally mounted sledgehammer to which is connected the loose iron core of a powerful "sucking" solenoid. The head of the hammer is suitably centered over the pipe-straightening channel on the table and a pair of wires is carried back from the solenoid to a long pedal contact, about 10 ft. distant from the hammer. With this apparatus the one man centers and sights a common length of pipe as before, but controls the time and force of the hammer blow by pushing on the foot pedal for longer or shorter intervals. Besides cutting the cost of labor in half, the solenoid-operated hammer enables one operator to do more work than the two did before, because the entire operation is completely under his direction and no delay is caused in giving or understanding



Solenoid-Operated Hammer.

instructions. The solenoid used measures about 1 ft. in length and 8 in. in diameter, and on closed circuit takes from 10 amp to 15 amp. A common sledgehammer is used, strapped to the pivoted beam as shown, and the back-stroke is controlled by the spring attached to the far end of the beam.

Chicago. Edward Hanlon.

THEATER DIMMERS.

In the answer to C. H. G.'s inquiry in the November issue of the *Electrical World*, about the construction of a choke coil for use as a theater dimmer, I think you did not make clear to the questioner that inductive devices are little or not at all employed for dimming purposes in modern theater installations. The difficulty of avoiding the frequency hum and getting abso-

lutely noiseless operation, which is frequently so important in theatrical scenic effects—to say nothing of the greater cost of such an impedance coil over a plain resistance rheostat—has put the choke coil practically aside as a stage-controlling device. Since most of the scenes during which the dimmers are used are comparatively short in duration, the loss of energy dissipated in the resistors is small and negligible, considering the superior adjustment and operation of the rheostatic device over the impedance coil or auto transformer. In several instances where continuous dimming service is required, as in church lighting, resistances have been used rather than impedances.

Newark, N. J. J. B. GAGE.

A PERPLEXING METER PROBLEM.

A meter on a residence service in a small town after running accurately for several months began to register backward. The meter was removed, but the new one set in its place also gave negative readings. Moreover, a shop test of the old meter

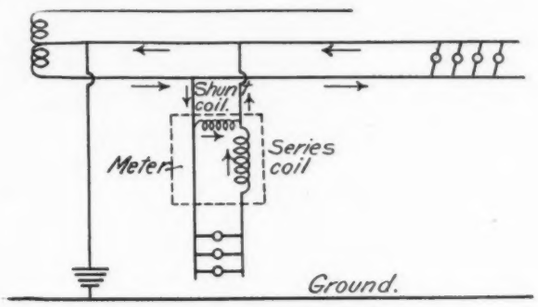


Fig. 1—Connections with Meter Rotating Forward

showed it to be correct. Repeated rough tests of the new one in service indicated nothing wrong and the mystery was deepening when on one occasion while examining the meter the disk suddenly began to turn backward at a rapid rate. Investigation showed reverse rotation took place whenever a kitchen lamp hung on a combination chandelier was lighted. On dropping the canopy the fixture was found to be hung without an insulating joint and when it was taken apart a bare place in the wire at a taped splice was found in contact with the gas pipe. Why the meter went backward puzzled every one to

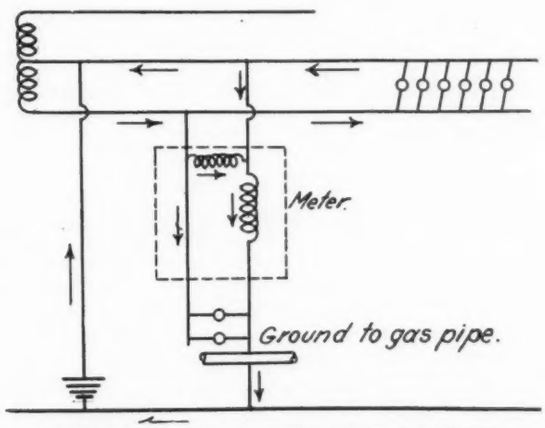


Fig. 2—Connections with Meter Rotating Backward.

whom the problem was presented for solution until the locations of the transformer, gas pipes and neighboring services were taken into consideration. The transformer was about two blocks distant from the residence in which the trouble occurred, and several other residences were supplied from it. The three-wire system of distribution with the neutral grounded to a water pipe was employed. The solution arrived at is best explained by reference to the accompanying sketches. With the normal instantaneous directions of the current, as shown in Fig. 1, the currents in the two meter coils are assumed to be in such relative directions as to cause the meter to rotate forward. Fig. 2 shows the directions which the current most probably took with the house wire grounded to the fixture. The two grounds together with the water and gas pipes and the house wires served as an auxiliary return to the transformer for the current from the several houses on the circuit. The current returning from the other services by way of this parallel circuit passed into the house with the defective fixture in a direction opposite to the normal current and, of course, gave the meter a reverse direction of rotation. Had the meter been connected properly—that is, with the series coil in the outside wire—the ground would have had practically no effect on the meter.

Lawrenceville, Ill. CALE GOUGH.

STARTING A SPLIT-POLE ROTARY CONVERTER.

In an article in your first issue for November Mr. W. R. Sherwood describes the starting of a rotary converter from the alternating-current side in terms that are apt to leave the wrong impression. He says: "Then the other two starting switches are closed successively, allowing time between the closing of each for the rotary to pick up speed, and when the last one is closed the rotary is running on full voltage and in synchronism and is ready for service." Strange to say, the author made this comment immediately after describing the "synchronizing" of the machine on the first starting tap. Attention should be directed to the point that the use of several taps in starting is not to bring the machine "up to speed" in successive steps, but to minimize the starting current. Unlike an induction motor, a rotary converter in starting is always unloaded and it will accelerate to full speed if it starts at all.

In the plant with which the writer is connected there are two 1000-kw rotary converters of the split-pole type fitted with the usual squirrel-cage winding on the pole-pieces for starting from the alternating-current side. One machine is started by means of a two-point auto-transformer and the other is provided with a small switchboard mounted in front of the transformers located near the machine. Use is made of two low-tension switches giving about one-third voltage for starting. The operation of starting is as follows:

With the switches in the starting position, the high-tension alternating-current oil switch is closed. The rotary converter accelerates to full speed and the "break-up" field-circuit switch is closed in the running position. A voltmeter on the panel shows whether it has "come in right"—it can generally be "caught" by watching the voltmeter and closing the field-circuit switch at a positive reading. Should it be reversed, however, the switch is left in this position, thus holding the rotary in step, although reversed, and the right-hand double-throw switch on the panel is thrown down, thereby putting two-thirds voltage on the machine; then this operation is repeated with the left-hand one, giving full voltage. Bad arcing would occur if an attempt were made to throw these switches with the machine running as an induction motor, as a heavy current of low power-factor exists. However, with the machine in synchronism the current decreases to a small value. The field-circuit switch may now be thrown down momentarily and the polarity of the machine reversed. The "break-up" switch for the split-pole windings is now closed. Going to the operating switchboard the main field current is adjusted for unity power-factor, the main split-field-circuit switch is closed and the excitation is adjusted until the voltage equals the line value, when the machine is thrown on the buses. The load is raised by means of the "regulating" (split-pole) field.

I think this will make clearer the starting of a rotary from the alternating-current end. The other details of operation for a split-pole rotary were given as these machines are still a curiosity in many places.

Schenectady, N. Y. A. R. HAYNES.

QUESTIONS AND ANSWERS

I wish to build a 60-cycle transformer for reducing the e.m.f. from 110 volts to 25 volts and delivering about 25 amp. What size and kind of wire should be used? How much iron should be in the core? H. J. H.

The primary could be wound with 110 turns of No. 12 double-cotton-covered wire properly insulated between layers and the secondary with twenty-five turns of No. 6 double-cotton-covered wire similarly insulated. The core, if built of fairly good iron sheets about 0.014 in. thick, should have a cross-section of about 10 sq. in. If a poor grade of iron is used the cross-section should be increased, while if the best grade of silicon steel is used the cross-section can be reduced to 6 sq. in. Each coil should be separately wound and separately insulated.

It is practicable to construct a series instrument transformer for use with a portable ammeter in such a manner that it can be inserted in the middle of a line? It is desirable to make use of a transformer that can be clamped around a leg of the circuit instead of being slipped on over the lead. R. D. C.

A transformer constructed as here indicated could be used with satisfactory results provided that the instrument were properly calibrated and that sufficient care were exercised when clamping the transformer in place. For a high degree of accuracy it is essential to keep the reluctance of the magnetic path at a low value and magnetic leakage should be minimized. High magnetic reluctance means proportionately large magnetizing current and hence incorrect current ratio. If possible to do so, it would be preferable to build the portable series transformer around a short length of conductor so arranged that it may be clamped to the lead as a shunt to a disconnecting switch which may be opened while readings are being taken on the ammeter.

I am redesigning a 0.07-hp direct-current motor with a two-pole laminated field core into an alternating-current motor of the repulsion type for operation at 110 volts. I have obtained very good results but am troubled with excessive sparking. Cannot the sparking be reduced by doubling the number of segments in the commutator, the slots in the armature remaining the same? What effect has the size of the winding of the armature upon the starting torque? R. O. S. A.

Neglecting the short-circuiting at the brushes, which produces the sparking, the performance of the plain repulsion motor is independent of the number of turns on the armature, provided only that the same amount of copper is used in each case. So far as concerns the commutating conditions it is desirable to use as large a number of commutator segments as possible and the fewest possible number of turns per segment. With a given motor frame the best results will be obtained when there is only one armature coil per commutator segment. One, two or even more coils can be used per armature slot. The commutator should be rather long so that the brushes need not be too wide.

What size wire should be used with a 50-hp, three-phase, 440-volt motor, the power-factor of which is 0.88 and the efficiency 0.90 at full load? The distance from the point of supply to the motor is 125 ft. C. G. W.

With 50 hp output at an efficiency of 0.90 per cent the input would be 55.5 hp, or 41.5 kw; at a power-factor of 88 per cent the apparent input would be 47.5 kw. At 440 volts the "equivalent single-phase current" would be 107 amp and the current per wire $107 \div 1.73 = 62$ amp. The National Electrical Code calls for a wire not smaller than No. 4 for this current. This wire has an area of 41,742 circ. mils and a resistance of 0.030 ohm per 100 ft. With 62.0 amp and a distance of 125 ft. the "resistance loss" would be 2.33 volts, which is 0.91 per cent of the e.m.f. to the neutral point, namely, 254 volts. The regulation would be satisfactory and the loss not excessive with this arrangement. Obviously a lessened loss with improved regulation could be obtained by using larger wire. The loss would be 0.355 per cent if use were made of No. 0 wire having an area of 105,592 circ. mils.

Would any trouble be experienced from inductive effects by drawing in two or more lead-covered cables into the same duct, each cable being the lead and return of a single-phase circuit operating at 2200 volts and a frequency of 60 cycles? Under what conditions would trouble be experienced in making use of steel conduit? It is proposed to run several steel ducts parallel and in actual contact with each other, each duct carrying a circuit as described above. B. C.

No trouble should be expected from using the lead covering of cables in the same conduit as the return circuit for the current in the conductors of the cables when single-phase current is used. In making the above statement it is assumed that the currents in the separate cables are obtained from the same single-phase system and are not derived from the separate phases of a polyphase system. On account of the inductive effects it is not advisable to place the outgoing and the return conductors of a single-phase circuit in separate iron conduits. However, trouble need not be expected from using single outgoing conductors in separate iron conduits used jointly as the return circuit provided the outgoing currents in the separate conductors are always in the same direction and not reversed. To sum up the above statements, it may be said that when one side of the single-phase system is completely grounded throughout all of the circuits it is permissible to use lead covering of cables, steel covering of conduit or any metallic material for the ground circuit. Care must be exercised, however, that only one side of the system is grounded, even when the separate parts of the system obtain their energies through different transformers.

A compensated repulsion motor operating at synchronous speed is said to exhibit zero voltage at all points along the commutator, which is short-circuited in one direction. Such being the case, why does not the machine more nearly resemble the single-phase induction motor with reference to its excitation? The latter motor consumes a certain amount of lagging wattless volt-amperes, and hence operates at all times at a low power-factor, while the former machine is said to operate at practically unity power-factor at synchronous speed. A. F.

It is not proper to assume that the performance of the compensated repulsion motor at synchronous speed is the same as that of an ordinary single-phase induction motor at the same speed, on account of the fact that all of the exciting volt-amperes for the single-phase induction motor are supplied in the primary circuit, while in a compensated repulsion motor the excitation at synchronous speed is supplied exclusively in the armature circuit. Tests have showed that the transformer circuit is composed almost exclusively of an apparent resistance, while the armature circuit represents almost exclusively an apparent reactance. At synchronous speed the apparent reactance of the armature reduces to zero, the total impedance of the motor circuits being confined almost exclusively to the transformer circuit, which consists almost wholly of apparent resistance. At synchronous speed the armature voltage in all directions reduces to zero. However, the magnetism has a very definite value, such as to produce the total counter e.m.f. in the transformer coil. This magnetism revolves synchronously with the armature. It is the motion of the armature conductors synchronously with the flux which causes the e.m.f. to reach zero value at synchronous speed. The current through the main armature circuit is just sufficient to produce this amount of field magnetism (alternating—not revolving) in line with the main brushes. The current in the short-circuit armature path is composed of two components, one of which is exactly equal to the current in the main armature circuit, but in time quadrature therewith, its value being such as to produce the (alternating—not revolving) flux in line with the short-circuited brushes so that no current whatsoever is needed in the transformer coil for the production of this flux. The two alternating fluxes in time and space quadrature combine to produce the revolving field.

Central Station
Management, Policies and Commercial Methods

WIRED HOUSES IN ST. PAUL, MINN.

From an estimate made by the commercial department of the St. Paul (Minn.) Edison Light & Power Company based on a study of electrical conditions in the city begun some time ago between 2000 and 2500 of the residences there are wired for electric light out of the 20,000 residential buildings which house St. Paul's population of 215,000. The city is spread over a territory unusual for this population, the corporate limits including fifty-nine square miles in area. Of the new houses built within the last year 35 per cent have been wired for electricity.

LARGE MOTORS REPLACE ENGINES IN MINNEAPOLIS FLOUR MILLS.

A number of large induction motors, ranging from 800 hp to 1500 hp in rating, have recently been installed in the great flour mills at Minneapolis, to take the place of individual engine units formerly employed in the various buildings. Modern turbine-alternator steam plants have been completed by two of the milling companies to supply energy to these large motors, which are usually rope-connected to the shafts formerly driven by the engines. The mills also purchase energy from the St. Anthony Falls Water Power Company, which has a development in the Mississippi River opposite the milling district of Minneapolis.

LOW-VOLTAGE TUNGSTEN SIGN HAS BURNED NEARLY 3500 HOURS.

The first low-voltage tungsten-lamp sign installed in Minneapolis, which was one of the pioneer cities to use these display illuminants, is still burning nightly after having operated continuously, five hours each night, from Feb. 2, 1909, to the present time, a total of nearly 3500 hours. During this time only one lamp has been replaced out of the total number of 154, which are arranged in eleven series groups of fourteen lamps in multiple each. For the purpose of repainting the sign the lamps were recently removed by the workmen and restored again without the loss of a single lamp, although no instructions had been given to the painters to use special care in handling the lamps.

PLACING AN IRON WITH EACH METER INSTALLED.

The battle of placing an electric iron in domestic service is half won after the iron is once safely in the house and the housewife's natural suspicion and curiosity are overcome by getting her to try it. A Wisconsin central-station company educates its customers in the right way, from the beginning of its business relations with them, by having its meter setters carry irons to the new consumers' residences, leaving these on thirty days' approval, which may be extended for an equal period if desired. Most of the irons placed in this way remain as the customer's property. In the town of 15,000, 300 irons have been placed in this way already this year, without employing other solicitors. The company makes free minor repairs and replacements on irons brought into its office, but does not encourage this service, giving each customer the impression that his own case has received special and unusual attention.

ELECTRIC TRUCK GARAGE IN ST. LOUIS.

What is said to be the only garage exclusively for electric trucks outside of New York has been opened at Twentieth and Locust Streets, St. Louis, by the Union Electric Light & Power Company. The experience of the company with its garage for electric pleasure vehicles has been highly satisfactory, and it is said that the number of vehicles of this class in St. Louis has grown from 11 to 375 in four years. The number of electric trucks in that city is placed at 150. The central-station company is convinced that electric trucking is more economical than horse service, and its commercial engineers are prepared to give comparative estimates on trucking as applied to any kind of business.

ELECTRIC VEHICLES IN DULUTH, MINN.

In spite of the heavy grades ascending the bluffs surrounding Duluth, the thirty or more electric vehicles in use in that city give their owners the best of service. The Duluth Edison Electric Company has made a special rate to owners of electric automobiles charging their cars in their own garages. For this purpose a separate meter is installed, and a charge made of 5 cents per kw-hour for all energy consumed, with a minimum bill of $4 per month. The company's distribution lines are all alternating current, and to those requiring converting apparatus it offers to furnish and install an automobile mercury-arc charging outfit complete for $212. The rate for "boarding" a car at the public garages in Duluth is $25 a month, including care and delivery.

LARGE MOTOR-DRIVEN PUMPS FOR MINNEAPOLIS WATER-WORKS.

The City of Minneapolis is preparing to install two 1200-hp motor-driven centrifugal pumps in the municipal water-works pumping station on the Mississippi River, five miles north of the city, each pump to deliver 20,000,000 gal. per day to a 50,000,000-gal. reservoir 247 ft. above the intake. Tenders have been asked and received for these first two units, which will be installed at once, and later the motor-driven pumping capacity of the station may be increased to 4800 hp by duplicating the original installation. The Minneapolis General Electric Company has offered to supply electrical energy for the pumping service from its Taylor's Falls hydroelectric plant at the rate of $3.63 for each million gallons pumped.

The city's specifications for the first two 1200-hp pumping units, as prepared by Mr. E. P. Burch, its consulting engineer, describe two-stage, horizontal, centrifugal pumps, each capable of delivering 20,000,000 gal. per 24 hours against a combined hydrostatic and friction head equivalent to 275 ft. and driven at 590 r.p.m. by 1200-hp, 2300-volt, 60-cycle, three-phase induction motors. From motor terminals to pump delivery the units will be required to show a combined hydroelectric efficiency of at least 75 per cent, while in the hope of obtaining still greater efficiency a substantial bonus is offered for each per cent by which this figure is exceeded.

The City of Minneapolis recently appropriated $600 to be expended on tests of an electrolytic system of water purification, in which it is proposed to reduce the number of bacteria existing in the water by traversing it with direct current at 600 volts.

STREET LIGHTING IN FALCONER, N. Y.

The board of trustees of Falconer, N. Y., has accepted the proposition of Mr. Fred Sprague, proprietor of the Falconer electric lighting plant, to furnish an improved street-lighting system. The new equipment will consist of 150 25-watt tungsten lamps, supplied and operated at a cost of $13 per annum for each lamp. This makes a total cost of $1,950 per year, compared with $1,600 which the village now pays, but the present service is by 16-cp carbon lamps and the system is said to be in poor condition. Mr. Sprague also agrees to furnish a cluster of four 60-watt tungsten lamps at the center of the village and to make no charge for this service. He agrees further to allow the village $4 a month for electricity consumed in the village hall. A meter will be installed in this building and if the monthly reading does not amount to $4 in value there will be no charge. Over $4 worth the village will pay at the rate of 5 cents a kw-hour. In installing the new lamps the overhead-line construction will be greatly improved. At present Mr. Sprague buys electrical energy from the Jamestown (N. Y.) Lighting & Power Company, but he is considering the possibility of building a plant to replace the one in Falconer, which was destroyed by fire some time ago.

MUNICIPAL PLANT SEEKING COMMERCIAL DEVELOPMENT BY CONTRACT.

Jamestown, N. Y., has a municipal electric lighting plant and it has recently entered into a contract with the Alliance Development Company by which the latter will undertake to increase the sale of electrical energy supplied by the plant for commercial purposes. The contract provides substantially that the soliciting company is to receive the first month's receipts from any new commercial customers secured and also 25 per cent of the receipts during the next three months. It is provided that all the business secured must be satisfactory to the electric light commissioners—that is, good profit-paying business.

In the meantime there are many complaints of the poor service rendered by the municipal plant in lighting the streets. For instance, on the last Hallowe'en night, Oct. 31, when there was particular need for street illumination owing to the pranks of mischievous boys, the whole city was in darkness for nearly an hour in the early evening because of some trouble at the plant. It is not strange that the Jamestown *Morning Post* declares that "It is high time that the board of lighting commissioners investigate the failure of the city lighting plant properly to illuminate the streets."

IMPROVED BOULEVARD LIGHTING AT NEWTON, MASS.

The Edison Electric Illuminating Company of Boston has completed an installation of 6.6-amp magnetite lamps on the boulevards of the City of Newton, superseding alternating-current inclosed arcs of about 400 cp nominal rating. Automobilists entering and leaving Boston by the Commonwealth & Brighton Avenue routes now have the advantage of driving on one of the best illuminated motor boulevards in the country, there being a continuous line of magnetite lamps now in service from the center of Boston to West Newton and Norumbega Park, Auburndale, a distance of about ten miles, half of which is within the Newton city limits. The lamps have been placed in the middle of the grassed reservations, but are turned to give a maximum illumination upon the portion of the roadway which is devoted to motor cars. About 107 new magnetite lamps have been installed in Newton and approximately 1500 tungsten lamps of the 40-watt size have been placed in service elsewhere in the city, superseding either inclosed arcs widely scattered or carbon incandescents of inferior power. All the dark corners of the highways crossing the railroad bridges have been provided with tungsten lamps. The arc lamps burn on an all-night schedule, but the incandescents are still operated on a 12:30 a. m. basis. The Edison company has offered to operate these on an all-night schedule for about $4,700 more per year than the present price. In spite of the great improvement in the lighting of the two main boulevards, the cost to the City of Newton will not be greater than under the old system. The new installation borders the electric railway lines throughout its entire length.

ELECTRIC TRUCKS IN NEW ENGLAND GAS AND COKE PLANT.

Three electric trucks which have been in service for several months in the plant of the New England Gas & Coke Company at Everett, Mass., show the possibilities of electric fuel delivery within a radius of eight miles of a large manufacturing installation. Each truck is of three tons capacity and was supplied by the General Vehicle Company. In August, 1910, the three trucks worked every day and showed for 81 truck-days a total of 779 hours 35 minutes time, with a total loss time due to troubles of only 9 hours 40 minutes, or about 98.7 per cent efficiency. The average daily mileage was 32.9 per truck and the average of the distance out and return was 4.3 miles. The average number of trips per truck per day was 3.9 and the average load carried per truck per day was 23,189 lb. Each truck is provided with two batteries and a change can be made in four minutes at the company's garage. The average run on the first battery was 18.7 miles and on the second 17.9 miles per truck per day. The trucks are provided with three compartments each and are equipped with motor-driven winches by which the bodies are raised for gravity delivery. It is estimated that the saving over the cost of horse delivery is about 42 per cent, including all charges.

CONTROLLED FLAT-RATE LIGHTING AT SUPERIOR, WIS.

The Superior Water, Light & Power Company, which retails hydroelectric energy purchased from the Great Northern Power Company, of Duluth, for resale among lighting and motor customers in Superior, Wis., offers a controlled flat rate to those residential consumers who desire to use a certain number of lamps without restrictions, paying a fixed sum each month. The rate charged is 1 cent per month per watt of connected lamp demand, the minimum controller setting being four 25-watt tungsten lamps, for which the monthly cost would be $1. The maximum rate under this schedule is $3 for 300 watts connected demand.

This flat-rate offer has now been in effect for about a month and more than 100 consumers have adopted it, the majority of these changing from the metered schedule, at which energy is charged for at 10 cents per kw-hour, with a minimum of 5 cents per 55-watt lamp per month. Since a number of consumers had small monthly bills averaging 75 cents or more a month, it was desirable to change these over to the flat-rate $1 minimum schedule. Many were attracted by the offer of unlimited hours of burning, but some have made the mistake of contracting for too little demand and so embarrass themselves with interruptions during short periods when they exceed the rated demand. Six 25-watt tungsten lamps is the average controller setting contracted for. Electric irons are connected in behind the controller at a flat rate of 60 cents per month, allowing unlimited use, and in case of social affairs the company offers to disconnect the controller for 50 cents an evening, the fee charged merely covering the cost of labor for resetting the controller.

RESIDENCE LIGHTING IN TORONTO.

In the City of Toronto there are a great many houses completely wired, but in which the electric light is not used owing to certain peculiar conditions applying in that city. In Toronto a house is sold or rented without fixtures, wall paper, interior furnishings and other conveniences always provided in the typical American city. All houses that are built in the newer or outlying districts of the city are wired for electricity, but coming from an old house to a new one the tenant invariably brings along his gas fixtures, and as many of the houses are piped for gas it is a simple matter to place the old fixtures in the new house.

To expedite the work of the salesman the Toronto Electric Light Company has maps made showing the houses that are wired and using electricity, those wired but not using, and those using gas exclusively, and also the factories that are using electricity, gas or steam power. The canvasser takes from the map the houses that are wired but not connected and solicits the occupants for business, thereby saving time and assisting very materially in finding the "shortest line between two points," for it is assumed that it is easier to induce a man to buy fixtures for a house that is wired than it is to secure a wiring and fixture order combined. The maps are kept up to date and have been found of great assistance.

USES FOR ELECTRIC FANS THE YEAR AROUND.

A live central-station company operating in southern Illinois is pushing its fan campaign into the fall and winter months. With the aid of the following advertisement it shows how useful a fan can be even if the weather is not warm. In explanation of the third paragraph it may be said that the company is situated in a latitude where houses with basements are comparatively rare and consequently the lower rooms particularly are very uncomfortable whenever unusually cold winter weather strikes the community. This condition applies to a considerable number of houses between the latitudes of St. Louis and Memphis.

WINTER USES FOR ELECTRIC FANS—YOU NEED THEM THE YEAR ROUND.

1. To keep frost from your store windows in winter. Blow air against the window panes and no frost can collect.

2. To keep flies from entering your store. Especially needed in cool fall weather. Blow air against the screen door entrances and flies will not light on the screen. Consequently a drove of flies will not enter every time the screen door is open.

3. To keep you from cold floors and cold feet in winter. If you live in a house without basement, you know how uncomfortable it can be because of cold floors in winter weather. Set an electric fan on the floor in one corner of the room and direct it upward so as to blow air up along the walls in the corner. This will draw the cold air away from the floor and force warm air down to take its place. The layer of cold air along the floor will disappear.

4. To heat up your steam-heated office more quickly on winter mornings. Set your fan in front of the radiator with the fan pointed up so as to blow air up through the radiator. The rapid circulation of air will bring your office up to comfortable temperature in a small fraction of the time which would otherwise be required.

5. To help your hot-air furnace heat the house more quickly on winter mornings or to force air to rooms that are hard to heat on the windward side of the house. Let us put a special fan motor in the cool-air intake of your furnace to force air to all the rooms of your house. If the house cools down during the night, you can bring it up to comfortable temperature very quickly in this way; in fact, in about half the time that would be required if you did not use a fan. If you have some rooms which are hard to heat when the wind is blowing on their side of the house, you can heat them positively and satisfactorily in this way.

6. To dry your hair after a shampoo. Ladies especially appreciate this.

WELCOME ARCH AT MUSKOGEE.

The Muskogee Gas & Electric Company recently presented to the City of Muskogee, Okla., the arch shown in the accompanying illustration, with the understanding that the municipality would keep it illuminated for a period of years. As can be seen, it is of very substatial construction, and is built entirely of steel. It contains 1500 4-cp tungsten lamps. The letters in the word "Welcome" are 8 ft. high and those in the word

Electric Welcome Arch at Muskogee.

"Muskogee" 6 ft. high. The arch is 90 ft. wide and the top is 55 ft. from the pavement. The supporting columns are capped by devices representing flaming torches, operated by the usual flashing arrangement. The sign is double-faced and stands on a principal street leading from the Missouri, Kansas & Texas Railroad depot to the business district. This arch is by far the finest thing of its kind in the Southwest, and as a result has, of course, created favorable publicity and is a good thing both for the city and for the Muskogee Gas & Electric Company. This is one of the companies under control of H. M. Byllesby & Company.

PUBLIC-SERVICE PUBLICITY.

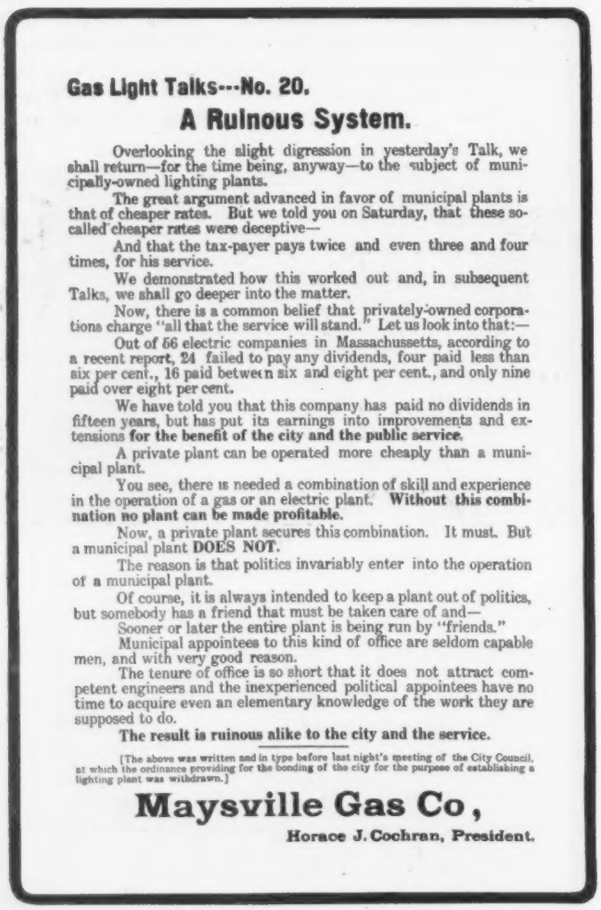
By C. W. Lee.

The abandonment of the time-worn "public be damned" attitude of public-service corporations could have no better illustration than is found in the growing use of the newspapers by the public utilities for the purpose of placing their side of debatable questions before the people. It is significant of the extent to which the advisability and even necessity of properly conducted newspaper publicity have taken hold of the minds of utility managers that the past few years have developed men and corporations who make a specialty of showing the company's viewpoint to the people it serves.

It is conceded that the old-time publicity methods, which consisted to a great extent of the subsidized publication of so-called "news stories," have become ineffective and, in many instances, positively dangerous to the interests of the utilities. What may be termed inspired news is always recognizable and always reacts upon the company or individual inspiring it. Publicity men realize this fact and have departed from these obsolete methods. The new idea involves the publication in all newspapers of a city of display advertisements written by men of broad experience in the newspaper and public-service fields. These advertisements are numbered consecutively and

tell the utility company's story fully and frankly, bringing out each point in its logical sequence. Obviously this advertising matter must be well written and the typographical display must be somewhat out of the ordinary in order to attract the reader. Given these conditions, publicity men have found that the company never fails to hold the public attention and interest to the end.

There can be no question about the advantages of the modern method over the old. In the first place, by paying for its advertising space the utility company is in a position to say just what it chooses and is responsible for what it says. Then,



Gas Light Talks---No. 20.

A Ruinous System.

Overlooking the slight digression in yesterday's Talk, we shall return—for the time being, anyway—to the subject of municipally-owned lighting plants.

The great argument advanced in favor of municipal plants is that of cheaper rates. But we told you on Saturday, that these so-called cheaper rates were deceptive—

And that the tax-payer pays twice and even three and four times, for his service.

We demonstrated how this worked out and, in subsequent Talks, we shall go deeper into the matter.

Now, there is a common belief that privately-owned corporations charge "all that the service will stand." Let us look into that:—

Out of 66 electric companies in Massachussetts, according to a recent report, 24 failed to pay any dividends, four paid less than six per cent., 16 paid between six and eight per cent., and only nine paid over eight per cent.

We have told you that this company has paid no dividends in fifteen years, but has put its earnings into improvements and extensions **for the benefit of the city and the public service.**

A private plant can be operated more cheaply than a municipal plant.

You see, there is needed a combination of skill and experience in the operation of a gas or an electric plant. **Without this combination no plant can be made profitable.**

Now, a private plant secures this combination. It must. But a municipal plant **DOES NOT.**

The reason is that politics invariably enter into the operation of a municipal plant.

Of course, it is always intended to keep a plant out of politics, but somebody has a friend that must be taken care of and—

Sooner or later the entire plant is being run by "friends."

Municipal appointees to this kind of office are seldom capable men, and with very good reason.

The tenure of office is so short that it does not attract competent engineers and the inexperienced political appointees have no time to acquire even an elementary knowledge of the work they are supposed to do.

The result is ruinous alike to the city and the service.

[The above was written and in type before last night's meeting of the City Council, at which the ordinance providing for the bonding of the city for the purpose of establishing a lighting plant was withdrawn.]

Maysville Gas Co,

Horace J. Cochran, President.

A Newspaper Advertisement for the Maysville Gas Company.

again, and this is a most important point, the very fact that the company is paying for the space it uses and is doing its own talking makes for public confidence—the most necessary requirement of a properly conducted and successful publicity campaign.

A recent demonstration of the wisdom of talking to the people through the medium of newspaper advertisements is found in the case of the Maysville Gas Company, of Maysville, Ky. The company, which also owns and operates an electric station, was having considerable trouble with its public and especially with the city administration. A remarkable fact is that the company's service, both gas and electric, was far beyond the average in cities the size of Maysville, not only in efficiency, but in the matter of rates. There was, however, a strong personal element to the controversy, having its origin in legal and political differences between the company's managers and the Mayor and certain members of the present and former city administrations. This was intensified to some extent by the attitude of the company, which went about its own business, within its rights, regardless of the administration's attitude. Matters were brought to a head, however, by the adoption by the City Council late in September of an ordinance providing for the establishment of a municipal lighting plant. Then the company decided upon publicity, and the firm with which the writer is connected was engaged to conduct the campaign. A series of daily "Talks," one of which is reproduced in this article, was prepared by a representative on the ground and published in the Maysville daily papers. It is interesting to note that the ordinance, which was to have been submitted to a vote of the people at the November election, was rescinded by the Council exactly two weeks after the commencement of the publicity campaign.

The company told the people facts not only about its own business but about the city administration. These facts were presented in conservative language, but in a manner that left no doubt in the public mind as to their genuineness. The administration was absolutely overwhelmed and withdrew the ordinance in the hope of stopping the publicity campaign. The "Talks" were continued for a full period of sixty days, however, and at the termination of the campaign the company's position in the friendly regard of the public was assured and, in the minds of the better class of citizens, the administration was discredited.

NEW-BUSINESS DISCUSSION AT ILLINOIS STATE CONVENTION.

At the convention of the Illinois State Electric Association held at Rock Island Oct. 26 and 27 several papers were presented on the subject of promoting new business.

Mr. T. P. Pinckard, new-business manager of the Peoria Gas & Electric Company, took a rap at some of the new-business methods which have been indulged in by some central-station companies the past few years. He advised new-business managers to judge well their own condition and be slow to attempt a solution of their troubles by way of the complicated routes laid out by some business managers. Some new-business department enthusiasts with all their card indexes and similar impedimenta seem intent on making a big job out of a little one. He criticised the continuous practice of putting out on free trial such current-consuming devices as toasters and irons. Referring to the efficacy of an iron or a toaster campaign, he said that one central station recently boasted of a 42 per cent sales factor as a result of a free-trial plan. This figure did not impress him as being nearly high enough to warrant the continuance of the campaign on the free-trial basis unless the article is being newly introduced. He would like to see a careful comparison of the profit and loss items under a sale conducted on this basis (including the expenses incidental to the scheme and the depreciation of the 58 per cent returned in dollars and cents) compared with the results of a direct and dignified "sold-to-stay-sold" plan energetically pursued. It is not to be denied that special periodical sales bring excellent results and should be conducted.

While the object of maintaining a display-room where various appliances are sold is to assist the company in making money, almost the first step the new-business department takes is to lose money on this feature, while a good, sustaining profit should be secured on the goods sold, and Mr. Pinckard said his experience is that increased current consumption will not suffer because of this policy.

Mr. Max Heiliger, assistant manager of the Rockford Electric Company, also read a paper on "How to Get New Business," in which he said that in conducting a successful campaign five cardinal points must be considered: Advertising, personal solicitation, courtesy, enthusiasm and service.

Under advertising, newspaper advertising is naturally the most important and gives the greatest returns for the amount expended, but it must be handled in a judicious manner or the money thus spent will be worse than wasted. The copy must be carefully prepared and the writer must be careful to stick to his subject, using few words and these right to the point

The heading and the first line or two of the advertisement will be read by practically every newspaper reader, and whether the rest is read or not depends entirely on the care and skill used in arranging these lines. There is, he said, a subtle flattery in a personal letter which appeals to the average man and makes such a letter effective in a new-business campaign. He recommended inclosing manufacturers' circulars with bills, receipts and other pieces of mail going out from the office.

If the field is not large enough to warrant employment of one or more solicitors, the manager or superintendent should devote a specific amount of time every day to solicitation. Unfailing courtesy should be shown under all circumstances and regardless of irritating conditions. There should be prompt attention to complaints, defective lamps, etc. Frequently an old consumer has a little grievance which can be rooted out and adjusted in a short friendly call, but which if related to a friend or neighbor will nullify the effect of many hours of earnest efforts.

Mr. O. C. Macy, superintendent of the Alton Gas & Electric Company, also gave a paper on "Some New-Business Ideas." He said that when he took hold in a town of somewhat less than 20,000 population he found a general lack of confidence in the reliability of electric service and a tendency among consumers to reduce bills with tungsten lamps rather than increase illumination. The company went to work to take up with each consumer the matter of improving conditions. The idea was to consult with the consumer and advise him as to how best to secure the illumination he desired.

In the case of a new hotel building considerable difficulty was experienced with the architect in getting a modern illumination layout, and the matter was taken up with the operating manager, who would have the bills to pay after the hotel was finished. As a result the company was allowed to make suggestions as to outlets, etc., which reduced the minimum bill paid by the hotel from $63 to $34 per month. The company also went after gasoline-lighting plants successfully by planning the customer's installation.

In the discussion Mr. R. M. Howard, of Washington, said that he knew of a flatiron campaign two years ago that cost the company $2 for each iron put out. He does not believe in giving the customer anything, as it is a reflection on the company's rates. Mr. S. B. Cushing, of Chicago, said that if a company can afford to give free lamp renewals, it can also afford to furnish flatirons free. No appliance consumes more energy in proportion to its first cost than a flatiron. Mr. T. W. Gregory, of East St. Louis, said that from 75 per cent to 98 per cent of the electric irons put out on trial remained in use.

Mr. John G. Learned, of the North Shore Electric Company, Chicago, told of the efforts of his company to get the wiring of residences on the instalment payment plan, taking twenty-four months for payment. A flatiron is included in the price of each such job of wiring. Of 200 houses so wired the average cost was $80 each. It is the practice of his company if flatirons are out of order to renew them free of charge. He believes in the free trial of any device which does not depreciate with use. He does not believe in putting the electrical supply dealer out of business by making a low price. He thought it a good plan for solicitors to call on old customers as well as new or prospective customers.

President Smith asked whether it is wise to let a contractor in a town continue to make 25 per cent to 40 per cent profit on wiring jobs. Mr. N. M. Argabrite, of Belvidere, said that in his town the company and contractors agreed on a certain set schedule of prices, and as long as these prices are maintained the company does not interfere. Mr. Frank J. Baker, of the North Shore Electric Company, Chicago, recommended a seven-day free trial for electric irons as being about the right length of time. One of the country members objected to such a short trial because, he said, people frequently have wash day only once in two weeks in the country towns.

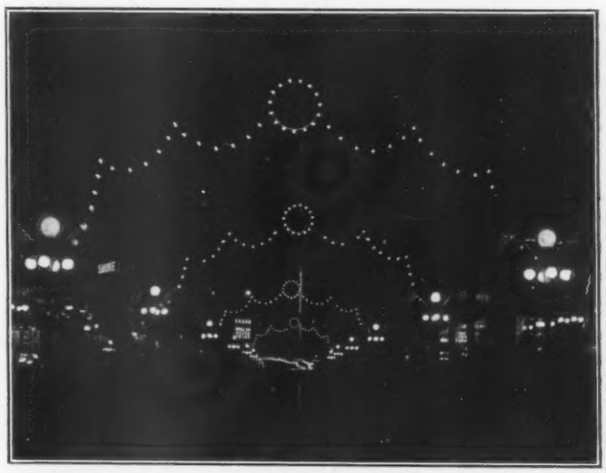
Mr. Argabrite said that he did not push electric irons in November and December, for the reason that electric light bills are increasing in those months and the consumer is likely to blame the electric iron for large bills. Mr. Bass, of Farmington, said that from 90 per cent to 95 per cent of the electric irons put out on trial had paid. Mr. Pinckard said that he objected to the circus method sometimes used of taking out large quantities of irons on a wagon on trial. If the consumer comes into the office and asks for a free trial, the company will give it, although if he is met by a good salesman the salesman can sell him the iron outright usually then and there. Mr. Learned said that some of the circus methods Mr. Pinckard condemned had resulted in increased income.

Mr. E. W. Smith, of Kewanee, expressed the opinion that the iron would soon be such a staple article that there would be no need for putting it out on trial. Mr. L. D. Mathes, of Dubuque, Iowa, expressed the opinion that there was much "buncombe" in current "new-business" ideas. The man on the job is the important factor. He did not approve placing advertising matter in with bills, because when a man opens the letter he may see the advertising first and throw it in the waste-basket before he sees that a bill is also contained therein.

Wiring and Illumination

DECORATIVE FESTOON LIGHTING IN MINNESOTA TWIN CITIES.

Advocates of the curb standard or post arrangement of ornamental tungsten street lighting make the point against the arch system that when the transverse spans are installed the maximum effect is at once reached, so that it is impossible to add to the appearance of the street by any other form of decoration for special occasions. The post system is not subject to this objection, for after the tungsten pillars are erected these lend themselves both artistically and electrically to the use of festoons or arches for gala lighting.



Decorative Festoon Lighting from Tungsten Posts in St. Paul, Minn.

Minneapolis and St. Paul, Minn., have extensive systems of ornamental tungsten pillar lighting, but during the recent Conservation Congress conference at St. Paul both of the neighboring twin cities enhanced the night appearance of their downtown streets by hanging festoons of lamps from curb to curb, giving to the streets the appearance of tunnels of light.

The Minneapolis tungsten pillars are furnished with energy from the Edison three-wire system, alternate posts being fed from the two sides of the circuit to preserve a balanced condition. The other outer wire of the Edison system is also brought

up to a terminal block in the base of the post. For installing the festoon lighting permanent anchor-eyes are mounted in the walls of the buildings and the spans are slung and energized through loomed cables inserted through holes in the tops of the pillars and connected to the terminal blocks in the bases. The pillars thus provide a simple and convenient means of energy supply for the festoons, avoiding stringing bus lines along the faces of the building walls. For the special Conservation Conference illumination in Minneapolis eighty festoons were hung, each containing fifty 20-cp graphitized-filament lamps, half of each festoon, or twenty-five lamps, being supplied through the pillar at the base of the span. This special decorative lighting was held in position and illuminated during State Fair week at the expense of the merchants.

The sister city of St. Paul appropriated $6,000 to purchase and erect 150 festoons of the type shown in the illustration, each containing fifty-two 8-cp carbon lamps. These festoons were caught up at intervals by hangers producing a fluted outline, and at the center of the spans 4-ft. metal rings, each carrying sixteen lamps, were installed. The festoons and lamps are the property of the city, to be used on any appropriate public occasion, and the hollow rings studded with lamps were intended to provide niches for letters or designs relating to the occasions on which the festoons may be used. The energy to operate these lamps was paid for by the city and during fair week the merchants defrayed the cost of the lighting. These festoons were supplied with energy through wires connected to the post lighting, as was done in Minneapolis. The lamps, wire and cable are all public property and are stored in the City Hall awaiting the next occasion of public decoration.

PARK BOARD FURNISHED DOWNTOWN LIGHTING AT VIRGINIA, MINN.

From a decorative standpoint probably one of the most attractively lighted small-city public thoroughfares is Chestnut Street, Virginia, Minn., where the park board has just completed an installation of fifty tungsten lamp standards along five blocks of the business section. The population of Virginia is 10,000 and the cost of installing the lamp-posts was met from the fund for beautifying the little city which had accrued in

Ornamental Tungsten Pillar Lighting, Chestnut Street, Virginia, Minn.

the hands of the park board. The handsome iron posts of massive design are erected at 60-ft. intervals along each curb and each post carries four 60-watt lamps and one 100-watt tungsten lamp inclosed in frosted-glass balls. The 60-watt lamps are operated from dusk to midnight, the top 100-watt lamp on each post burning all night. For supplying the energy for this installation the Virginia Electric Power & Water Company receives $5.25 a month for each 340-watt post, the city making its own repairs and renewals. The cost of erecting the fifty posts, complete with underground construction, repaving, etc., was $5,500.

A SWITCHBOARD WIRING PIT.

By Edgar M. Thurber.

Wiring around switchboards in stations of small capacity is not always as neatly and systematically installed as it might be. Frequently the feeder conductors are brought to the board from above and even if they are neatly arranged they obstruct the light and constitute a lodging place for dust. Leads from generators usually are carried in ducts beneath the station floor and rise to their lugs on the switchboard panels from below. This is a neat arrangement and it at once suggests to the small-station designer that, under favorable conditions, it is best to bring all conductors to a switchboard from below rather than from above.

When circumstances are such that it is feasible to bring wiring to panels from below it can readily be arranged for in buildings not having basements through the construction of a "wiring pit" like that suggested in Fig. 1. The pit is excavated to a depth of from 4 ft. to 5 ft. at the time the building is erected. It has, in the example shown, brick walls and a con-

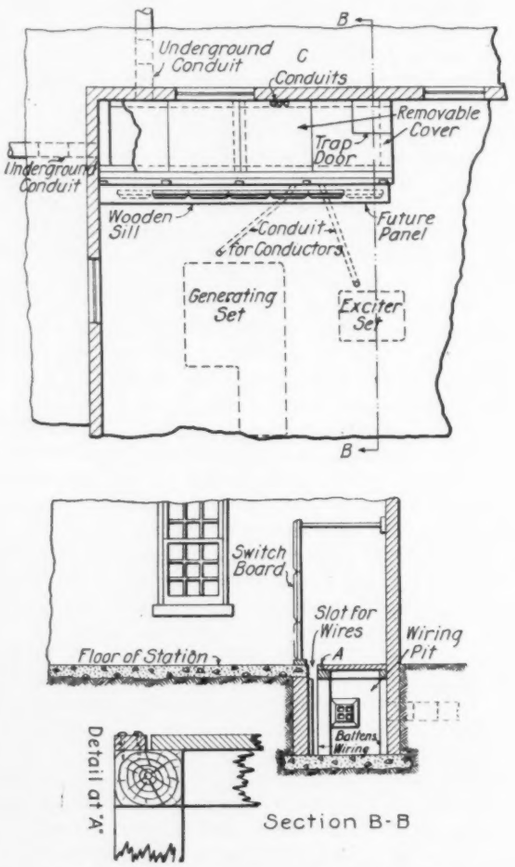


Fig. 1—Wiring Pit Back of Switchboard.

crete floor. In Fig. 1 the conductors from the generator and the exciter sets are conveyed, in wrought-iron conduit, beneath the floor, from the machine terminals to the wiring pit. Four feeders (Fig. 2) enter the pit through vitrified underground conduit and three more enter from above through vertical wrought-iron conduits secured to the face of the station wall with pipe straps. Within the wiring pit all of the conductors are supported in porcelain cleats, held on wooden battens arranged on the pit walls, as illustrated in Fig. 3. The cleats (see detail in Fig. 3) are of the single-wire, split type and are clamped into position with wood screws. The battens are secured to the pit walls with lag screws turning into wooden plugs inserted in the brickwork.

A temporary floor, shown in Fig. 1, is provided over the pit. It consists of sections of such size that they can be readily

handled. These sections are supported on a timber framework (Fig. 1). A trapdoor is located in one corner, so that

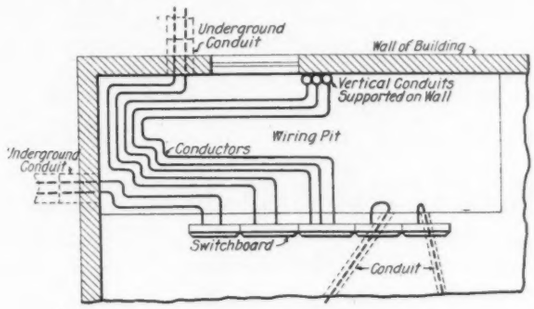


Fig. 2—Arrangement of Wiring in Pit.

the pit can be entered without the necessity of removing an entire floor section. A slot, extending the entire length of the pit, at the side adjacent to the switchboard, permits the conductors to be carried vertically upward to their respective lugs on the panels. As indicated at detail "A", Fig. 1, a strip is nailed along the edge of the section-supporting timber to retain the floor sections in their proper locations.

In Fig. 4 is shown the method used in constructing the entrances of the underground conduits. The vitrified conduit extends only about half through the wall and a portion of the inner wall is chamfered all around at an angle of about 30 deg. to meet the edge of the conduit. The wall face is thus formed so that the conductors entering the pit through the conduit will not have to be bent sharply where they leave the conduit, as they would have to be if the end of the conduit length were flush with the true inner surface of the wall. Sharp bends must

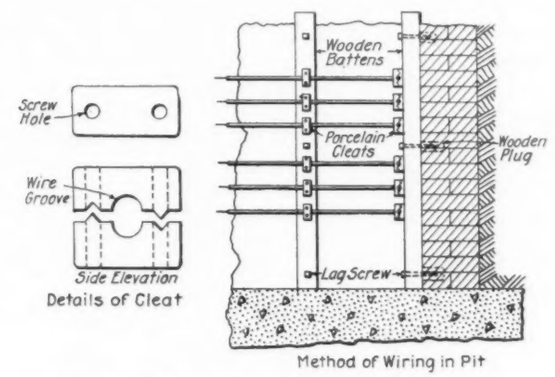


Fig. 3—Method of Supporting Conductors in Pit.

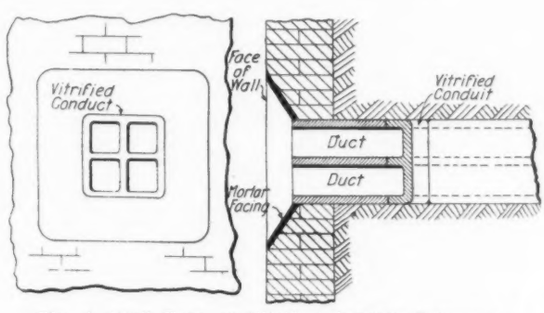


Fig. 4—Wall Face at Vitrified Conduit Entrance.

be particularly avoided where lead-sheathed conductors are involved. Where the wrought-iron conduits conveying the generator and exciter leads enter the pit the wall is similarly recessed, as detailed in Fig. 5.

In arranging the wiring within the pit all conductors should be carried around the walls, as shown in Fig. 2; none should be permitted to cross it, except at the ends. This procedure will involve more copper than if the most direct route is selected in each case, but it will doubtless be the most economical in the long run, because it will insure ease of inspection and will leave practically the entire pit unobstructed. There should

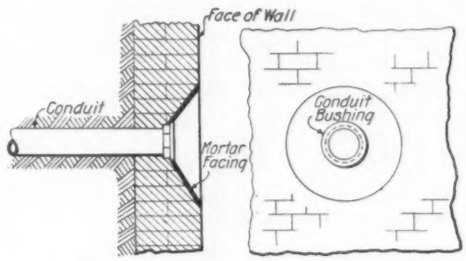


Fig. 5—Wall Face at Iron Conduit Entrance.

always be ample room in a pit for the wiremen and for the tackle used in drawing conductors into the conduits.

LETTER TO THE EDITOR.

The Design of Shunt Field Windings.

To the Editor of Electrical World:

SIR:—In Mr. Frank W. Merrill's article on "The Design of Shunt Field Windings" in your first issue of October an inexact formula appears to be deduced from an incomplete statement as to the effect of using two sizes of wire.

Taking the case of the addition of a smaller wire, if the given area A_1 is first filled by T_L turns of the large wire, then, adopting Mr. Merrill's symbols and the wires being assumed uninsulated as in Mr. Merrill's equations (1) and (2), the new total number of turns after the substitution of T_S turns of the small wire is

$$T_L \frac{(A_1 - A_2) + (A_2 \times 1.26)}{A_1}$$

$$= T_L \left(1 + \frac{T_S}{T_L} \cdot \frac{0.26}{1.26}\right)$$

The factor of change of the *turns* is, therefore, $1 + \frac{T_S}{T_L} \cdot \frac{0.26}{1.26}$ but this is not the factor of change of the *ampere-turns*. For the same excitation the amperes will also have changed; they will be reduced and are now proportional to

$$\frac{1}{T_L + T_S \left(1.26 - \frac{1}{1.26}\right)}$$

instead of to $\frac{1}{T_L}$

(The mean length of turn for the coil entirely wound with one size of wire is here also assumed to hold for each of the two portions—a condition which would exist if they were wound side by side to the full depth of the winding space.) The factor of change of the *amperes* is, therefore,

$$\frac{1}{1 + \frac{T_S}{T_L}(0.466)}$$

the factor of change of the *ampere-turns* is, then, the product of the two, and it is this which has to be equal to $\frac{1}{F}$, where F = the ratio of the cross-sections of the large and correct wires. Hence it follows that

$$T_S = T_L \frac{(F - 1)}{0.466 - 0.266\,F}$$

a result which can be easily put to the test by actual trial.

If D = the diameter of a wire when insulated and d = the diameter of the bare wire with suffixes S, L, C for small, large

and correct sizes, the true formula for equal mean length of turn is

$$T_S = T_L \cdot \frac{\left(\frac{d^2_L}{d^2_C} - 1\right)}{\frac{d^2_L}{d^2_S} - \frac{d^2_L}{d^2_C} + \frac{D^2_S}{D^2_L}\left(\frac{d^2_L}{d^2_C} - 1\right)}$$

Lastly, if the small wire is wound below the large wire the varying length of the mean turn of the two portions forbids a simple solution which shall be rigorously true, but in practice it is only then necessary to remember that the above value for T_S is too small and that it should therefore be increased by about 10 per cent.

London, England. C. C. Hawkins.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Transient Phenomena in Starting Direct-Current Machines.—A. Schwaiger.—The author investigates the gradual rise of the voltage at the terminals and of the exciting current of a self-exciting direct-current generator driven at constant speed when the excitation circuit of the machine is suddenly connected to the terminals of the armature or when the resistance of the excitation winding is suddenly changed. The author describes a graphical method giving the gradual rise of the voltage at the terminals and of the exciting current and states that the curves thus obtained agree well with curves obtained experimentally by means of an oscillograph. This is at least the case for machines with laminated poles. However, when the machine has solid poles the theoretical curves differ from those experimentally determined. This is due to the fact that the eddy currents in the iron are not taken into consideration in his theoretical method.—*Elek. u. Masch.* (Vienna), Oct. 30.

Maintaining Constant Voltage at Varying Speed.—E. Schulz.—An article on a method of keeping the voltage of a generator constant, while the speed varies, without the use of an automatic shunt regulator. The method requires the generator to be of liberal design, its magnetism curve to be practically a straight line within the limits of operation, and that a battery must be available and the generator be coupled with a small exciter. Let Z be the amp-turns required at lowest speed to produce normal voltage. With a straight-line magnetization curve the amp-turns required for double the lowest speed are $z = \frac{1}{2} Z$. The generator is provided with a double magnet winding, as shown in Fig. 1. The stronger of the two windings

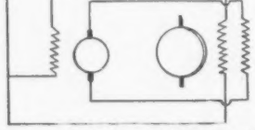


Fig. 1—Generator with Double Magnet Winding.

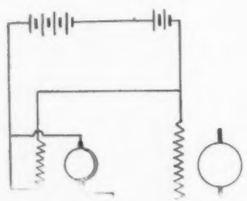


Fig. 2—Generator with Two Separate Magnet Windings.

is connected to the battery (x amp-turns, x being constant) and the smaller winding is fed with energy from the exciter. The magnet winding of the exciter is also connected to the battery. If the amp-turns of the second smaller magnet winding of the generator are y at lowest speed, they are $2y$ at double the lowest speed. The two magnet windings must be connected so as to oppose each other. From the equations $2z = x - y$ and $z = x - 2y$ there are obtained $z = y$ and $x = 3z$. That is, the amp-turns of the second smaller portion of the magnet winding at the lowest speed must equal the total effective amp-turns at double speed, and the amp-turns of the larger battery-connected portion of the magnet winding must be three times the total effective amp-turns at double speed. Under these conditions the voltage is the same at lowest speed and at double the lowest speed, but it is not the same at intermediate speeds. A numerical example is given in which there are voltage variations of 6 per cent above and below an average voltage while the speed is raised from its lowest value to double this value. The connections can also be made in a different way in which two separate magnet windings are not required. The method is shown in Fig. 2.—*Elek. Anz.*, Oct. 30.

Leakage Coefficient of Induction Motor.—R. E. Hellmund.—The conclusion of his mathematical article in which he gives a collection of formulas by means of which the different items making up the leakage coefficient of an induction motor can be calculated with an accuracy sufficient for practice. The formulas are not empirical, but are derived from theoretical considerations. They are, however, simplified for practical use. A numerical example is added.—*Elek. Zeit.*, Nov. 10.

Windings.—A continuation of the very long illustrated serial on windings of dynamo-electric machines. In the present instalment large direct-current machines are discussed with reference to the core, the coils, the armature cross-connections, the winding of the armature, banding and balancing.—*Elec. Journal*, November.

Transformer Tests.—E. F. Collins.—In a continuation of his very long serial on commercial electric testing, tests of three-phase air-blast transformers, oil-cooled transformers and oil and water-cooled transformers are dealt with.—*Gen. Elec. Review*, November.

Lamps and Lighting.

Flame-Arc Lamp.—A description of the Gallois flame lamp recently placed on the market in Great Britain. It is of the vertical-electrode type, as shown in Fig. 3, with regulating mechanism of the differential type. The shunt and series solenoids A and B are separate, and are provided with cores $a\,b$, suspended from a beam E by chains a^1, b^1, the beam being carried on knife-edges e. The ends of the cores are coned to give uniform pull, and the shunt core is ballasted with a weight in conjunction with the counterweight b^4. The electrode holders are carried by a flexible cord or chain passing over the pulley f, and the upper holder is heavier than the lower, so that their tendency is to run together. A train of gearing ending in a star-wheel F^1 controls the pulley, being coupled to the rocking beam by a link E^1; the frame carrying the train is mounted upon knife-edges eccentric to the axis of the pulley f, so that when the frame is tilted, the star-wheel being held from turning by the stop f^1, the pulley is rotated slightly and the arc lengthened or shortened. The series core is provided with an air dash-pot C of special construction, the piston having holes c^3, and a light aluminum disk c^1 beneath it, supported by the screw c^2. On closing the circuit the series solenoid is strongly energized, and tends to cause an abrupt downward motion of the core, but the aluminum disk, acting as a valve, closes the holes in the piston and brings the dash-pot into play. The shunt dash-pot is similar, but inverted. On the cessation of the current, on the other hand, the electrodes are liberated by the free fall of the shunt core, and come together quickly. In normal working the dash-pots exert only a weak control, allowing the beam to respond to the least differences of pull of the two solenoids, and to keep the arc steady; and when the arc burns to too great a length the shunt core descends sufficiently to allow the star-wheel to rotate slightly, thereby feeding the electrodes, after which the shunt core rises and the star-wheel is again stopped. For continuous current the upper (positive)

electrode is cored and the smaller negative is solid. The lamps can work three in series on 110 volts, or five on 220 volts. They are also made for alternating current, and work with either ordinary carbon or flame electrodes.—*Elec. Review,* Nov. 11.

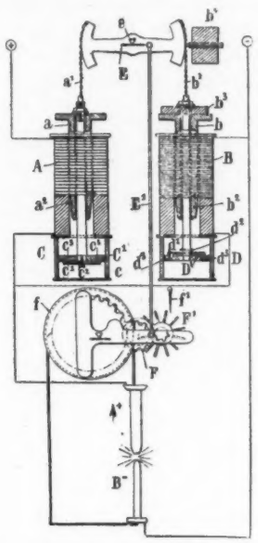


Fig. 3—Gallois Flame-Arc Lamp.

Quartz Lamp.—M. LEBLANC, JR.—A review of the principle of the quartz-globe mercury-vapor lamp, giving some details of construction and results of tests.—*La Lumière Elec.,* Nov. 5.

Tungsten Filament,—A note on a recent British patent (23,437, Oct. 27, 1910) of E. Ruhstrat (Göttingen, Germany). In order to obtain finer and stronger filaments for processes in which the tungsten is mixed in the form of a powder with a binding material and then squirted the tungsten is reduced to a very fine powdered state by first heating it to a temperature higher than its melting point in an arc and then suddenly cooling it. The product is extremely brittle and can be ground so fine that it approaches the colloidal state.—Lond. *Elec. Eng'ing,* Nov. 3.

Theater Lighting.—A note on the lighting equipment of the Palladium Theater of Varieties in London. The fittings for the interior allow for an aggregate of approximately 1200 lamps, while a large number of special signs and arc-lamp brackets will be mounted on the exterior. Tantalum and "one-watt" lamps and arc lamps will be employed exclusively for the lighting.—Lond. *Electrician,* Nov. 4.

Traction.

Switzerland.—Statistical data on the hydroelectric stations of Switzerland. The development of water-power began in 1886. At the end of 1890 there were in existence twelve hydroelectric stations, with a total rating of 4000 hp. The highest rating of a single station was originally 1000 hp, but this had increased to 18,000 hp and 16,000 hp in 1897, and works in course of erection will have still larger ratings. The highest e.m.f. for transmission was 18,000 volts in 1901 and is now 50,000 volts. Energy is transmitted over distances of 100 km and 200 km (60 miles to 120 miles). The use of some storage system is of great importance. Of the 152 hydroelectric plants existing in 1907 sixty-five had steam reserves with an aggregate rating of 50,000 hp. Other low-pressure water-power plants use a water-storage system. An excellent method of utilizing all the water is to combine a low-pressure plant with a high-pressure plant with storage lake. Data are given on some of the more important plants, also of the financial returns of fifteen stock companies having a stock capital of more than $200,000 each. These figures show that interest on the capital is paid only after from two to six years. Last year the dividend for these fifteen companies varied between 3 per cent and 8 per cent, the average being 5.3 per cent. Data are also given on some municipal plants which appear to be in a good financial condition, since most of them have paid back the borrowed capital to the municipality and have written off considerable amounts for amortization. Some of them have also had a net gain, but most of the municipal works prefer to reduce the price of energy instead of making a net gain. The price of the kw-hour for lighting in eleven different municipal plants in 1909 varied between 1.6 cents and 13 cents, the mean value being below 10 cents. The rates charged for industrial purposes differ greatly in different cities. These hydroelectric developments have enabled Switzerland to become to a certain extent independent of other countries for supply of coal, or at least to keep the import of coal approximately constant since 1900, in spite of the enormous growth of the industries since that time. When the Swiss railroads become operated electrically the import of coal will be greatly reduced.—*Elek. Zeit.,* Nov. 3.

Electric Equipment of Coal Mines.—An illustrated description of the electrical equipment of the Oakdale navigation collieries in the South Wales and Monmouthshire coal field. There are two pits and the generation station is midway between them. There are two 1000-kw, 3300-volt, 50-cycle, 1500-r.p.m. mixed-pressure turbo-alternators. The turbo-alternators supply the whole of the energy for lamps and motors, both for the surface and for the sinking operations, and will ultimately supply the necessary energy for the fan motors for ventilating. Direct current is used in connection with the arc and incandescent lamps on the surface and in the various buildings. This is supplied by means of a 220-volt motor-generator set in the generating station. The energy for the surface, and also for the sinking operations, is obtained from a step-down transformer, which lowers the pressure from 3300 volts to 550 volts. This pressure has been adopted for all of the motors on the surface and also for the motor-driven air compressor and the sinking pumps.—Supplement to Lond. *Elec. Eng'ing,* Nov. 3.

Energy from Peat.—N. CARO.—The author and Frank have developed a method of utilizing peat by a process analogous to the Mond gas process. In a gas producer the peat is subjected to the action of air and steam and is thereby changed into a gas which can be utilized in gas engines. At the same time 85 per cent of the nitrogen in the peat can be recovered in the form of ammonia, which is transformed into ammonium sulphate and sold as a fertilizer. If the peat contains 1 per cent of nitrogen the ton of dry peat yields 40 kg of ammonium sulphate, and if the peat contains 2 per cent of nitrogen it yields 80 kg of ammonium sulphate. This "by-product" is stated to pay almost for the whole cost of the process. The producer gas obtained thereby contains from 1250 to 1350 calories per cubic meter, and per ton of dry peat from 650 to 750 electric hp-hours can be obtained from the gas by means of gas engines, and in continuous operation 900 hp-hours. Such a peat-fuel generating station is now nearing completion in the Dammermoor in the Province of Hanover, in Germany. This will have ultimately a rating of 4000 hp, but for the present only 2000 hp will be used. Energy will be supplied to the City of Osnabrück and neighboring villages. In peat districts where there are no towns the electric energy can be utilized for drainage, etc., since the development of the peat deposits should be carried out in such a way that when the peat is removed the ground will be ready for agriculture.—*Elek. Zeit.,* Nov. 10.

Gas and Oil Engines.—C. THONET.—An article on the use of gas engines, Diesel oil engines and Hornsby gasoline engines as prime movers in central stations. Statistical data are given to show that the gas engine operated with producer gas is more economical than any steam engine at a rating below 500 hp and can compete even with the Diesel engine when the price of crude oil is beyond a certain figure. However, in districts where oil is cheap the Diesel engine becomes preferable on account of its numerous technical advantages. This accounts for its great development in England.—*La Lumière Elec.,* Oct. 29.

Energy Required for Rolling Mills.—J. A. KNESCHE.—An account of tests of the energy required by a direct-driven plate

mill. In the first instalment the author describes the arrangement of the tests and the influence of temperature in rolling steel and pyrometers suitable for such work. In the second instalment he gives the results of his tests in form of extended tables and diagrams. He discusses the influence of material and size of rolls on the energy requirement and the cost of energy in rolling mills and compares the accuracies obtained on steam-driven mills and electrically driven mills.—*Eng. Mag.*, November.

Installations, Systems and Appliances.

Barcelona.—An illustrated description of the electricity supply in the City of Barcelona in Spain. There were two steam plants each of 900 hp in operation in the eighties, and a large new plant was erected in 1897. The latter plant contained originally five steam-driven direct-current generators each of 1000 hp, to which was added later a direct-current steam-driven set of 2000 hp. Including the storage battery the equipment rating is about 8000 hp, direct-current energy being supplied by the three-wire system with 200 volts between the outers for lighting and industrial purposes, besides energy at 500 volts for traction. Energy is distributed by means of a cable network with a bare middle wire, the total length being 550 km (330 miles). In order to supply energy to the outlying districts a three-phase plant was erected in 1906, originally with a rating of 4500 hp, which has since been increased to 19,000 hp. The plant contains three turbo-alternators, each of 1000 kw, two of 3000 kw and one of 3600 kw. Three-phase energy is generated at 6000 volts and transmitted to ninety-eight transformer stations, of which thirty-five are in public places and sixty-three in factories.—*A. E. G. Zeit.*, November.

Electric Energy from a Tug.—During the fitting out of the White Star liner *Olympic* the necessary electrical energy for lamps and motors is being supplied from a tug which is moored alongside the larger vessel. This tug has on board an electrical plant with a rating of 320 kw and has also been fitted with a powerful steam fire pump. It is, therefore, both a floating generating station and a fire station, in addition to being a tug. The *Jackal*, as the tug is called, was formerly a gunboat on the China station and has engines rated to 1500 hp. For the purpose of driving the electric plant the shafting connecting the propeller with the engine has been uncoupled to enable the latter to drive the electric plant.—Lond. *Electrician*, Nov. 11.

Distance Between Transformer Stations.—C. Schmidt.—The conclusion of his paper in which he discusses the considerations which determine the most favorable distance between transformer stations in electric distribution systems. He shows especially how an increase of the distance between transformer stations changes the cost of energy distribution and he also shows what voltage variations are caused by suddenly connecting a 5-hp motor to the mains. He finally makes definite proposals as to permissible voltage variations when such a motor is connected to the mains.—*Elek. Zeit.*, Nov. 3.

Wires, Wiring and Conduits.

Pin Insulators and Suspended Insulators.—G. Benischke.—An account of comparative experiments with pin insulators and suspended insulators under high tension and under the effect of artificial rain. For some types of suspended insulators consisting of a series of several insulators the perforation voltage was found to be considerably less than the sum of the perforation voltages of the single insulators. Moreover, with these same types of insulators it was found that the invisible discharge (characterized by noise without light and indicating that with increasing voltage visible discharges will be obtained) occurred at an earlier stage than with pin insulators. The author's experiments show that the cause of this is to be found in the capacity of the insulator.—*Elek. Zeit.*, Nov. 10.

Earth Return.—A note stating that for more than a year a committee of the Swiss Electrical Society has had under observation the use of earth as a return conductor between St. Maurice and Lausanne, and a report of the committee states that the system has worked satisfactorily without a single derangement from the moment when it was put in regular service. Direct current at 20,000 volts is used on the Thury system with a single line conductor, the second line conductor having been idle during the past fourteen months. No complaints have been made by the engineers of the federal railways, the compensating batteries installed at certain stations having absolutely prevented interference with the railway signals.—Lond. *Elec. Review*, Nov. 4.

Electrophysics and Magnetism.

The Nature of Electrical Discharge.—F. E. Nipher.—An abstract of a paper read before the Academy of Sciences in St. Louis. The writer presented photographic plates treated by electric discharges as follows: Pin-head terminals rest with their rounded heads upon the photographic film. One terminal is grounded, the other leads to a variable spark-gap at the negative terminal of an influence machine, the positive terminal being grounded. Pictures are taken for discharges with varying spark-gaps. A theory of the electric discharges is based on these pictures and the following application is made to the electric discharge in a vacuum tube. It follows the tube in all of its windings and bends, not because it is a convection column, but because it is a drainage column. The conditions are different from those in a copper wire in that the parts of the atoms which constitute the conductor are in gaseous form and are capable of yielding to the force which urges them in a direction opposite to that in which the negative corpuscles are being urged.—*Science*, Oct. 28.

Electrons.—J. W. Nicholson.—The author has formerly considered the theory of the motion of a conducting sphere the mass of which is purely electrical under the action of either a small uniform field of electric force or a small mechanical force. In the present paper the motion of such a sphere devoid of the Newtonian mass is investigated, and it is shown to present none of the difficulties noticed in the case of the conductor. He concludes that it may be preferable in any attempt to treat the electron as not subject to deformation to endow it with dielectric rather than conducting properties. The analysis of this hypothesis presents no difficulty which does not appear to be shared by the other, and in consideration of initial motions it gives rise to great simplicity in the possible case of no Newtonian mass.—*Phil. Mag.*, November.

Beta Particles.—A paper by A. F. Kovarik on the absorption and reflection of the beta particles by matter; another paper of A. F. Kovarik and W. Wilson on the reflections of homogeneous beta particles of different velocities; and a paper by J. A. Gray and W. Wilson on the heterogeneity of the beta rays from a thick layer of radium E.—*Phil., Mag.*, November.

Electronic Theory.—H. A. Wilson.—A discussion of some difficulties which the electronic theory in its present form encounters in its application to the optical properties of metals.—*Phil. Mag.*, November.

Magnetism.—A summary by D. Owen of the various researches of the late Prof. Pierre Curie on magnetism.—Lond. *Electrician*, Nov. 4.

Franz Neumann.—A lecture by P. Volkmann on the experimental work in physics of the late Franz Neumann.—*Phys. Zeit.*, Nov. 1.

Units, Measurements and Instruments.

Action of the Condenser in the Ruhmkorff Induction Coil.—I. W. Waghorn.—The author describes experiments made for the purpose of determining what oscillations are set up in a condenser bridging a spark-gap on a circuit arranged like the primary of an induction coil, more especially when the circuit is made and broken by a mercury motor interrupter. It is shown that there are two sets of oscillations in the "long and short circuits" of the condenser, respectively, and that both these sets may be present at the same time, the "short-circuit" oscillations having the greatest intensity at small and the "long-circuit" oscillations at large values of the condenser capacity. It is shown that the "short-circuit" oscillations are increased in amount by increasing the inductance of the main circuit and

that with the mercury interrupter the maximum sparking distance of the secondary circuit occurs approximately when the "short-circuit" current is a maximum.—Lond. *Electrician*, Nov. 11.

Recording Instruments.—D. BERCOVITZ.—An illustrated paper on recording electrical instruments made by the Paul Meyer Company for both direct current and alternating current. Various records of curves are reproduced. The paper deals especially with the recording device. Its special feature is the arrangement of the ink well separate from the measuring system. This determines the use of a relatively large ink well, simplifies attendance and reduces cost of maintenance.—*Elek. Zeit.*, Nov. 3.

Oscillograph.—L. T. ROBINSON.—An illustrated description of the principle and construction of the oscillograph with various curves taken by this instrument and illustrating especially transient phenomena, for instance, first rushes of current on a short-circuit, variations of the current of a lamp immediately after closing the circuit, etc.—*Gen. Elec. Review*, November.

Telegraphy, Telephony and Signals.

Long-Distance Telephony.—An account of the extended discussion on this subject at a recent Paris international conference of telephone and telegraph engineers. Lucas, one of the reporters, said that experience and data, as shown in the paper by Bela Gati upon cables with Pupin coils interposed in aerial lines, proved that in order to obtain the best results from any ordinary cable it was necessary to regard the electric constants of the cable in conjunction with the constants of the aerial lines and of the apparatus connected to the cable. It could thus be theoretically decided whether or not to insert Pupin coils. From Gati's second paper on microphones the following conclusions may be drawn: In comparing transmitters for vocal efficiency it is necessary to ascertain that the electric conditions of the circuit tested do not produce a false impression owing to the resonance effects arising in the secondary circuits. In regard to the new transmitter of Egner and Halstrom it was shown that if the construction of telephone transmitters be modified in order to obtain an instrument better responding than the present types to the superior frequencies of sound, and permitting also the use of strong currents, the distances regarded to-day as easily practicable by the voice can be considerably increased. Gati's third paper on telephonic relays was practically the corollary of the former, all the more because he recommends high-speaking transmitters in connection with telephonic relays. Generally he suggests a relay in the line circuit so placed that sufficient intensity of current is available for line working and then the use of several relays on the same point, each relay being tuned as perfectly as possible to a certain frequency. The deductions in Martin's paper are as follows: (1) The best result is obtained by the use of lead-covered cables, the insulator being spiral paper wrappings. (2) By the suitable interposition of Pupin coils upon these cables transmission results can be increased 370 per cent, and with a continuous and uniformly distributed inductance—that is, with a continuous spiral of iron wire on the copper conductor—transmissibility is increased 60 per cent, while 100 per cent can be obtained under certain special conditions. (3) Telephonic relays are not yet sufficiently perfected for commercial use. (4) The total equivalent in units of the standard cable of any number of aerial circuits of different construction connected in series is equal to the sum of the various parts. Pleijel said the following conclusions could be drawn from the statement of Petritsch: To obtain the greatest advantage from interurban lines of large diameter it was necessary to connect in the circuit only cables with high self-induction even for cable lengths of less than 8 km (5 miles). When the cable length does not exceed 20 km (12 miles) it is found that with the same copper diameter (2 mm, or 79 mils) speech transmission is not improved by using several iron spirals or Pupin coils. By using a pupinized cable with self-induction of 30 millihenrys per kilometer (48 millihenrys per mile) and by diminishing the copper to 1.5 mm (59 mils) diameter a cable is obtained without reflection at the extremities and of which the coefficient of attenuation is the same as that of the Austrian interurban cable. This cable would be cheaper and, for long distances, better than the Krarup cable with iron spirals. There is also reason to think that in aerial lines of great diameter the increased resistance of the coils due to Foucault currents may cause inferior articulation. Carty referred to two wires from New York to Chicago of 3.25 mm and 5.25 mm which form a "combined circuit" telephonically, while each wire is used for duplex telegraphy. In response to Breisig he said that this line has no special coils and that the apparent circuit (circuit fantome) is really the better. He replied to Hollos that there is to be no relay on the New York-Denver line, with which it is hoped to speak over 3540 km (2200 miles). O'Meara stated that in England cables are stranded in pairs and in fours, but tests do not show appreciable differences. Gill remarked that experiments in England upon combined circuits confirmed what Carty said. The improvement is manifest both in cables and in aerial lines. Carty, in reply to Luschen, answered that he had no definite data as to the pupinization of combined circuits. Devaux-Charbonnel said that in France several combined circuits are used without showing improvement, which can be explained by the doubling of the capacity, while resistance and inductance were halved. However, wires of large diameter have a greater effective resistance on account of the Thomson effect and may cause greater enfeeblement in combined circuits. Linninger explained that in Austria difficulties had been experienced with cables of 0.8 mm (32 mil) diameter and experiments had been made with several pairs laid parallel, but conversation became less distinct. Bela Gati said that in Hungary combined circuits had succeeded with aerial lines, but not with cables. Breisig, speaking on the subject of pupinized and Krarup cables, said that recently Sir John Gavey had not recommended cables with iron spirals. In his own opinion, the efficiency of a cable depends upon its construction. There is a great difference between the results given by Petritsch and Martin. According to the former it appears that three times the efficiency can be obtained by using iron spirals. The improvement with a Krarup cable would thus be similar to that of a Pupin cable, and the choice between them is, therefore, an economic one. Germany possesses only Krarup cables, 400 m to 500 m (1300 ft. to 1600 ft.) long, interposed in the aerial lines in their passage through small towns. In this case Krarup cables have been found preferable, notwithstanding their higher cost. He asked the English delegates to explain why their results with Krarup cables were so different from those in Continental Europe. O'Meara said that English officials invited by Krarup to Denmark to test his cables found the improvement obtained was 60 per cent. For the new Anglo-French cable the sole condition demanded was a coefficient of attenuation not exceeding 0.014 and manufacturers have proposed pupinized cables to the exclusion of the Krarup type. Petritsch remarked that experience showed that cables with iron spirals have double the efficiency of those without, and that in all cases of cables with copper conductors of large diameter those with high self-induction are best. Where Pupin coils would not be used for any reason, as for short lines, copper conductors with iron spirals give the best result.—Lond. *Electrician*, Nov. 4.

Frequency of Telephone Currents.—At the recent international conference of Telegraph and Telephone Engineers in Paris the following resolution was passed: "In practical calculations telephonic current may be replaced by a sinusoidal current. As regards intensity, a mean vibration of 5000 may be adopted. Vibrations of 3000 to 7000 should be regarded, in addition, where questions of tone (timbre) are concerned."—Lond. *Electrician*, Nov. 11.

Telephone Exchange.—A description of the new telephone exchange in Hamburg which is to replace the former eight exchanges in Hamburg, Altona and Wandsbeck. The central-battery system is used and the exchange is at present equipped with 40,000 parties, which will be doubled.—*Elek. Zeit.*, Nov. 3.

Book Reviews.

Railway Signaling in Theory and Practice. By James Brandt Latimer. Chicago: Mackenzie-Klink Publishing Company. 420 pages, 140 illus. Price, $2.50.

The fundamental theory and practice of signaling systems and apparatus for steam roads form the subject of this book. The electric railway man will find little which will interest him, as electric railway signaling differs considerably from steam road practice. The book covers manual, electric, pneumatic-electric and various other kinds of signal systems, and gives complete specifications for mechanical and power interlocking signal systems.

Handy Man's Workshop and Laboratory. By A. Russell Bond. New York: Munn & Company. 465 pages, 370 illus. Price, $2.

This book has been compiled from the Handy Man's Department of the *Scientific American*. It contains a large collection of kinks classified and presented with clearly made illustrations. The classification of the kinks is as follows: Equipment of a workshop; constructional details and instructions in the use of tools; soldering and preparation of solders; kinks for machinists; experiments and experimental apparatus; directions for building useful things about the house; directions for building and repairing various kinds of sporting paraphernalia. The man who uses tools and likes to make things and do repair work will find this book a regular mine of useful information.

New Apparatus and Appliances

ELECTRICALLY WELDED LAMP GUARDS.

One of the most valuable features of the lamp guards illustrated herewith is the electrically welded joints. The wires are welded at every place of meeting so that there is no need of tie wires, springs or catches to hold the guard together. The wires are so welded that they cannot be pulled apart, the weld being as strong as the wire itself. No part of the lamp is touched by the guard, but every part is evenly protected.

Figs. 1 and 2—Lamp Guards with Electrically Welded Joints.

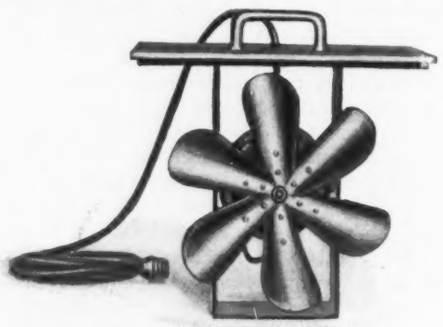
The locking guard shown in Fig. 1 is provided with a solid metal top which locks to the rib on the socket shell. It is locked by means of a key and cannot be removed without the key.

The guard that is shown in Fig. 2 is made of wire throughout, and is so proportioned as to nest perfectly, so that eight can be packed in a box that will hold only two non-nesting guards. This guard is provided with a wire-spreading bottom so that it will stand erect upon a bench or moving machine.

The above described guards are made by Harvey Hubbell, Inc., Bridgeport, Conn.

EXHAUST FAN BLOWERS FOR FURNACES.

At this season of the year, when hot-air furnaces are being put into use, good circulation of fresh air through the heating system and the rooms of a building is a subject deserving of a great deal of attention. Fresh air is more essential to good health than heat, and a good heating system must provide for the circulation of fresh air. Of the many schemes advanced the most practical seems to be a fan blower placed in the cold-air box. The Western Electric Company has just added to its list of well-known "Hawthorn" motors a line of exhaust-fan blowers. This device consists of a moderate-speed motor mounted on a supporting frame attached to a cast-iron cover plate driving a six-blade fan. This cover plate is provided with a lifting handle by means of which the blower can be easily removed from the cold-air box if desired. No starting box or auxiliary equipment is necessary. A 10-ft. lamp cord and socket are provided and connection can be made to any lamp socket. The motor, which requires no attention whatever, is of simple construction and reliable. The exhaust-fan motor blowers are made to operate on both 110-volt and 220-volt direct-current circuits and 110-volt and 220-volt single-phase alternating-current circuits having frequencies of 60 cycles or 40 cycles.



Exhaust Fan Blower.

INSULATED TESTING CLIP.

The testing clip illustrated herewith is provided with a protecting covering of insulating material, which, however, in no way interferes with the action of the clip. The nose upon which the connection is made is the only part that is exposed. The device is well suited for use with magneto and microphone testing sets and with voltmeter and in general laboratory work. It is intended for use by electric lighting and transmission companies, telephone companies, wire manufacturers, railway-signal inspectors and general electrical manufacturers. It has been placed on the market by R. S. Mueller & Company, Cleveland, Ohio.

Testing Clip with Protecting Covering.

SPEED REGULATOR FOR SMALL MOTORS.

The type of controller shown in the accompanying illustration is built for use with standard motors rated at from 0.05 hp to 0.17 hp, 250 volts. The operation is by means of a simple sliding lever with which seven contacts are made furnishing seven running positions without an "off point" or six running positions, with the seventh contact an "off point."

The resistor, which is the important feature of any regulator,

Speed Regulator.

is moisture-proof and dustproof. It consists of a porcelain core on which the resistance wire is wound and over which a special cement is applied which entirely incloses all portions.

These regulators are adapted for motors operating such devices as fans, jewelers' and dentists' lathes and drills, copying machines, adding machines, washing machines, coffee mills, sewing machines, small blowers, buffers, etc. In addition to controlling the speed of motors it may be used for controlling heating circuits in connection with plating baths and as a field regulator for small dynamos.

The diameter of the regulator is 6 in., the depth of casting 1⅝ in. and the net weight only 2.5 lb. It is made by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis.

COMPRESSION-TYPE BATTERY-CHARGING RHEOSTATS.

The American Electric Fuse Company, of Muskegon, Mich., has just installed a complete battery-charging outfit in the new Delmar Avenue garage of the Park Automobile Company, St. Louis, consisting of thirty charging rheostats. The service de-

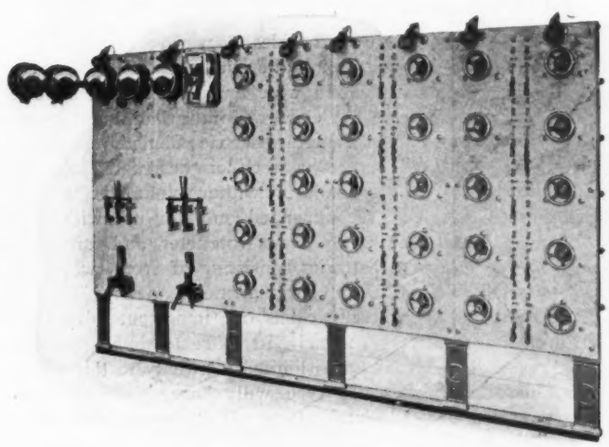


Fig. 1—Front View of Board.

mands rheostats which will charge twenty-four to forty cells at a rate of from 0 amp to 30 amp from a 110-115-volt circuit.

The features in the American Electric Fuse Company's apparatus which render them particularly adapted for this class of work are the flexibility of the compression type of rheostat, which permits a single machine to operate through a wide range and affords very close regulation; the compactness of the type, the small amount of panel space occupied, the neat apearance of the apparatus and the saving in cost of installation. The installation is illustrated herewith.

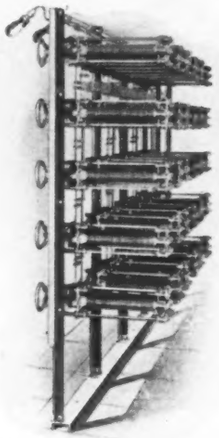


Fig. 2—Rear View, Showing Rheostats.

Another installation of the same rheostats was recently made for the Vandalia Railway at Terre Haute, Ind. It included complete equipment for charging the electric lighting plants on Vandalia cars and is now in successful operation.

THREE-WIRE GENERATORS.

For obtaining the neutral point for three-wire operation of the generator illustrated herewith, use is made of "balancing coils" consisting of three interconnected windings upon laminated iron cones. It is claimed that, even with heavy unbalanced loads, the machine operates with absolute sparklessness. Two or more of these generators can be operated in parallel with each other or with two-wire machines.

The two-voltage feature of three-wire distribution is particularly advantageous for buildings or shops where variable-

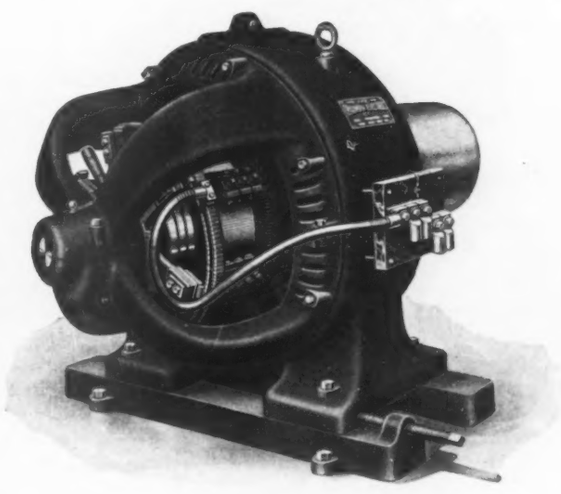


Fig. 4—Three-Wire Generator.

speed motors are in use. With field control a wide range of speed can be obtained on account of the flexibility of the system; at the same time the saving in copper is quite a considerable item. The three-wire generators are well suited for supplying energy to lamps and motors in large stores, office build-

ings, etc., and for general use in manufacturing establishments. The above-described machines have been placed on the market by the Triumph Electric Company, Cincinnati, Ohio, in all

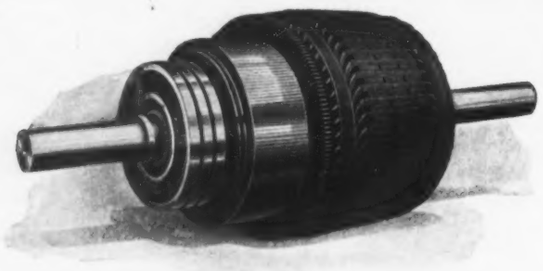


Fig. 2—Armature of Three-Wire Generator.

standard ratings from 25 kw up, wound for 250 volts, so that 125 volts can be obtained from either side of the three-wire system.

ELECTRIC LIGHTING OF AUTOMOBILES.

The Hartman Electrical Manufacturing Company, Mansfield, Ohio, has brought out an automatic system of electric lighting for automobiles consisting of, first, a 6-volt generator driven from the engine shaft by belt, chain or direct-connected gear drive; second, a battery which floats on the line and supplies current when the car is at rest or the engine is running below generating speed; and, third, a regulator, operating to maintain constant voltage at all engine speeds. The generator shown in Fig. 1 is of the four-pole, closed, iron-clad type with a field ring of special steel having a high permeability. The armature is built with closed slots with coils wound of a single large wire. Imported ball bearings are used, properly selected with reference to the work to be performed. At a speed of a little above twelve miles per hour it will generate about 9 amp, or sufficient to supply all the current needed for

Fig. 1—Automobile-Lighting Generator.

head, side and tail lamps and ignition. The maximum output of 15 amp is reached when the car is going at a speed of about fifteen miles per hour.

As the engine speed varies from 0 r.p.m. to 2000 r.p.m. and as the speed of the generator will be proportional, it is obvious that some means must be provided for governing the output of the generator and maintaining a constant voltage at the lamps and battery. The regulating device for this purpose is contained in the iron box shown in Fig. 2, which contains also the terminal board, switches and fuses. Two relays are used, one for operating the main switch, which is placed between the generator and the battery, and the other for controlling the shunt field circuit. When the car is at rest or the generator is running below the speed necessary for charging and for maintaining the lamps at proper voltage, the main switch remains open, thus cutting out the generator and preventing the battery from discharging through the generator armature. Whenever the engine attains a speed sufficient to drive the car at about twelve miles per hour the generator picks up the load and the main switch is automatically closed. The lamps, if in use, are then carried by the generator and the surplus current is fed into the battery until it becomes fully charged. When the speed of the generator increases the second relay comes into action and by means of an ingenious device weakens the current to the fields, causing the voltage to drop instantly to the proper value. The result is a practically constant voltage at the battery and lamps, the variation being less than ¼ volt over a range of speed from 1200 r.p.m. to 6000 r.p.m. Ideal conditions for charging the battery are thus obtained, the current flow being greatest when the battery is low and tapering off

Fig. 2—Voltage Regulator.

gradually as the battery becomes fully charged. As the generator voltage remains constant at a point below the maximum voltage of the battery on charge, there is no possibility of overcharging the battery. Whenever the engine speed falls below approximately ten miles per hour the dynamo is automatically cut out, and the battery then carries the full lighting load. Three switches are used for the head, side and tail lamps. Sockets for plugging in a trouble lamp are also provided in the regulator box. A "turn-down" feature is provided in connection with the head lamps by means of which the lights can be turned down about one-third. The system is entirely automatic and requires no attention other than the occasional oiling of generator bearings.

NEW TYPE OF RECTIFIER OUTFIT.

The mercury-arc rectifier provides a very convenient and efficient means of transforming alternating current to direct current and is meeting with a wide application in this field. To meet the demand for a less elaborate outfit than its universal battery-charging one the General Electric Company has recently placed on the market a rectifier designated as the "Runabout type." This is made up without voltmeter or ammeter and is, therefore, recommended only for use with cars that are equipped with a first-class voltmeter and ammeter. It is designed to charge batteries consisting of from twenty to thirty-two cells at a maximum charging rate of 30 amp.

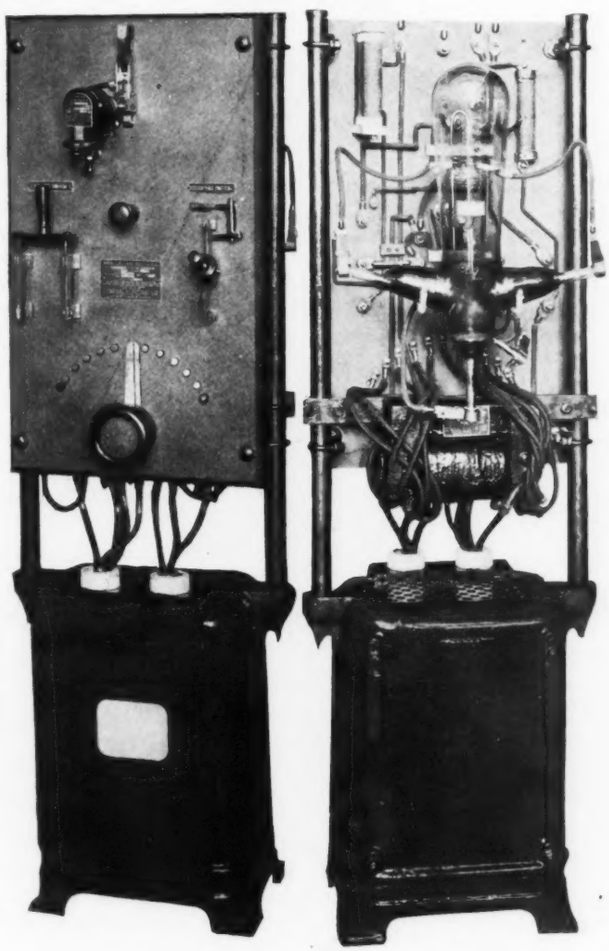
The "Runabout type" rectifier has one important advantage over the "Universal" type, namely, its extreme simplicity. As will be noted above, its range is limited to twenty to thirty-two cells, while the "Universal" type will charge from five to forty-four cells of lead-plate battery. The former thus does not require special and elaborate means of adjusting current and voltages, and has only one small dial switch, which gives a range of fine regulation sufficient for any battery from twenty to thirty-two cells. This will make a set appeal to the many men and women who want to charge their own electrics, but perhaps hesitate to tackle the apparently slightly more complicated "Universal" type.

Figs. 1 and 2 show front and rear views of the new rectifier,

which is self-supporting. The panel pipe supports are screwed into suitable receptacles on the compensating reactance, which is of sufficient weight to hold up the rectifier panel and its equipment. The outfit consists of four essential parts, mercury-rectifier tube, compensating reactance, regulating reactance and panel with supports.

The tube is mounted in a holder located on the back of the panel. The shaft of the holder extends through the panel and is connected to a hand wheel on the front by means of which the tube is tilted when starting the outfit. Fig. 2, which shows the back view of the rectifier panel, illustrates the form of the tube holder. The manufacturers call particular attention to its simplicity and to the evident ease with which a tube can be inserted.

The function of the compensating reactance is to maintain the arc in the tube while the alternating current is passing through the zero point of the cycle. This reactance is so arranged that



Figs. 1 and 2—Single-Phase Mercury Arc Rectifier.

one lead is a negative pole of the rectified current, while the other leads are arranged so that the reactance can be used as a compensator (thus its name, "compensating reactance") so that by a few changes the outfit can be used on either 110-volt or 220-volt alternating-current supply circuits and be able to charge a maximum of thirty-two cells.

Fine regulation of the direct-current voltage is accomplished by means of a regulating reactance which is connected in the alternating-current line. This reactance consists of a coil wound upon one leg of a rectangular laminated core. The coil has eleven taps, which are connected to studs on a dial switch mounted on the front of the rectifier panel. The latter is of natural black slate, 28 in. x 16 in. x 1½ in., and it is equipped with all switches necessary for the operation of the rectifier and the regulation of the charging current.

INFUSIBLE AND INSOLUBLE INSULATING MATERIAL.

The General Bakelite Company, of New York City, is the manufacturer of a certain synthetic product possessing many valuable characteristics for insulating purposes. Chemically the substance is known as oxybenzyl-methylenglycol-anhydride, but it has been given the trade name of "bakelite." It possesses some of the combined properties of amber, hard rubber and celluloid. It has not the flexibility of rubber or celluloid, however, but it is harder and stronger than either of them, withstands heat and is not attacked by any solvents nor by most chemicals. The substance is totally insoluble and infusible and does not soften even at a temperature of 572 deg. Fahr. It may be obtained either transparent or opaque and can be compounded with various filling materials, such as asbestos, clay, wood-pulp, minerals, etc., and shaped or molded with great accuracy to articles of unusual strength. It can be sawed, turned and polished and when used to impregnate wood

Fig. 1—Strain Insulator.

and other porous bodies renders them harder and more resisting to chemical and physical influences. Motors can be impregnated with the raw material and by a simple process of heating under pressure synthesis of bakelite takes place in and around the fibers which cover the wires of the coils and as a result the whole is transformed into a hard, infusible, insulated mass. Bakelite has been employed for making a variety of electrical insulating devices, a number of which are illustrated herewith. The material does not emanate sulphur like hard rubber nor nitrous products like celluloid. If heated

Fig. 2—Brush Holder.

in a flame it does not suddenly catch fire like celluloid nor melt like rubber; it simply chars, then burns with difficulty.

The bakelite process involves the utilization of three distinct and well-defined varieties of the substance, designated bakelite A, bakelite B and bakelite C. Bakelite C is the final product, whereas bakelite A and B are the transition products. Bakelite A is the initial raw material and exists in liquid, pasty or solid condition. All varieties of bakelite A are still soluble in alcohol, acetone or caustic soda and behave as true resins. Bakelite A which is solid at ordinary temperatures

Fig. 3—Weatherproof Socket.

melts if moderately heated. If stronger heat is applied it becomes infusible and insoluble and changes into bakelite B or C.

Bakelite B is an intermediate solid product characterized by the fact that although it is infusible it will soften under the action of heat and then be molded and welded together if pressed in a hot hydraulic press. Bakelite C is the final product resulting from the application of heat to forms A or B and

lacks all the chemical characteristics of a resin, although physically it may resemble amber. It has maximum strength and maximum resistance to chemical influence.

Aside from the molded insulators in which bakelite is employed as a binder, bakelite varnish is employed with considerable success in the electrical industry as an improvement over shellac varnish. It is applied like the latter, but after drying it can be hardened and made infusible. For varnishing coils, coated wire and similar substances its advantages are obvious. Cotton-covered wire may be impregnated with bakelite varnish, then dried and wound into coils. If heat is afterward applied the bakelite is transformed into the infusible variety C. As long as this transformation has not taken place the wire has the usual flexibility, but after the change the protected wire does not lend itself readily to bending. Asbestos-covered wire protected with a thin layer of bakelite varnish produces a wire conductor which will withstand unusually high temperatures and which, furthermore, does not readily absorb moisture. The bakelite-prepared article has the great advantage over one made with shellac that it does not soften with heat and withstands better the action of oil in transformers. It has been used in transformer bushings for extra high potentials, withstanding tensions as high as 275,000 volts. The various forms of bakelite are applicable to such a variety of uses that it is necessary to specify exactly what use is intended to be made of it in order to obtain the proper variety.

Fig. 4—10,000 Volt Insulator with Bakelite as Binder.

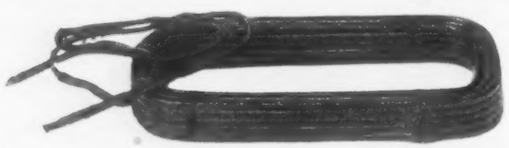


Fig. 5—Coil Impregnated with Bakelite.

SPECIAL FIXTURES FOR HIGH-CANDLE-POWER TUNGSTEN LAMPS.

The accompanying illustrations show some new fixtures made by the Federal Electric Company, of Chicago, for 500-watt tungsten lamps. These lighting units are designed for both outdoor lighting and where it is desired to illuminate large indoor areas. The fixture illustrated in Fig. 1, intended more particularly for indoor work, has a 20-in. inverted glass bowl shade, with 10-in. opening, and a spun-glass dome 10½ in. in diameter. A 6-in. white porcelain-enameled steel disk, wired, with a large-base socket, is also provided. The fixture is suspended from a 7-in. canopy by a chain attached to a 1-in. casing depending from the canopy. The standard finish for this fixture is brush brass.

Fig. 2 illustrates a less ornamental fixture, suitable for outdoor work. There is a 20-in. porcelain-enameled steel shade, black on the upper side and white on the inside. This is attached to a 12-in. black porcelain-enameled steel dome. As in the former fixture, there is a 6-in. white porcelain-enameled steel shade, wired, with a large-base socket. The lamp is protected against theft or breakage by a clear-glass dome, with an opening at the bottom, and so attached at the top that there is a good circulation of air. An iron stem, 18 in. long, connects the fixture to the canopy.

Fig. 1—500-Watt Tungsten-Lamp Fixture.

Fig. 2—500-Watt Lighting Unit with Outer Globe.

A street hood has been designed for large tungsten lamps used for street lighting, and it may be suspended with a chain and pulley combination in the manner shown in Fig. 3. The support is obtained from three equidistant points, making the hood stable and level. It is said that with this suspension the tungsten filament will not be broken by the highest wind. The steel cone is 7 in. high, and the shade is 15 in. in diameter. The three-arm support, or rigger, is of iron, fitted with three insulators. The wiring enters the hood through two porcelain

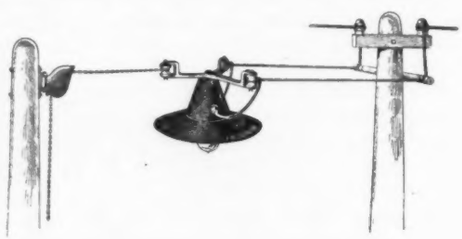


Fig. 3—Street Hood for 500-Watt Tungsten Lamp.

bushings, and a socket cap with special thread to fit the G.E. large-base series socket is provided. This socket will automatically close the circuit in case the lamp burns out or is broken, so that all other lamps in the series will remain burning. The two lead wires form one side of the support, and the third arm is supported by a chain or rope, which passes over a pulley on a pole on the opposite side of the street. When the rope is tightened the hood is held firmly in position.

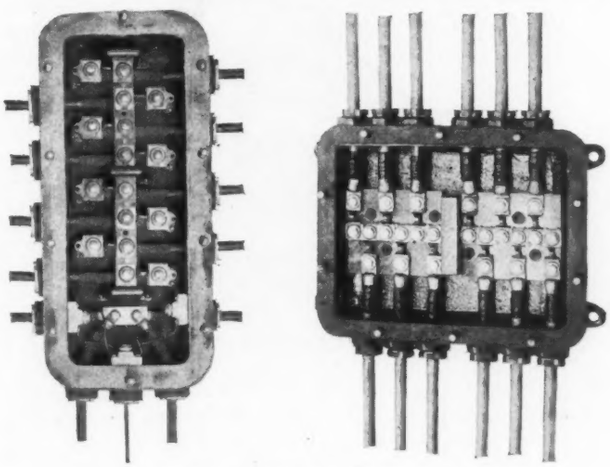
UNDERGROUND JUNCTION BOXES.

By W. E. Hazeltine.

The accompanying illustrations show a line of low-tension junction boxes made by the General Electric Company and designed to meet all ordinary requirements of underground work.

M. D. JUNCTION BOX.

The manhole distribution junction box (Fig. 1) is designed to interconnect mains at street intersections or to serve as the center of distribution at feeding points. It is made for two-wire circuits and for three-wire circuits where the neutral cable is grounded and not brought into the box. This type of box is intended for single conductor cables in manholes, but may also be used on poles or in cellars. It is substantially made of cast iron with heavy arched covers and fitted with molded rubber gaskets. All the nuts and exposed fittings are of a composition metal that will not rust or stick even when the boxes remain closed for long periods. The busbars are mounted on non-combustible supports and the inner face of the cover and the ends of the box are protected by asbestos shields. The terminals can be soldered on to the cables outside of the box. Standard copper fuses are used with these boxes. Stuffing boxes of the engine type are provided for the entrance of the



Figs. 1 and 2—Junction Boxes.

cables, but where manholes are likely to be flooded brass nozzles are recommended to which the lead sheath can be united by a wiped joint. The boxes, designed to take both feeder and main cables, are fitted with special stuffing boxes for the introduction of a pressure wire cable if it is desired, and have taper holes in terminals and busbars for jumper cable which is used to shunt a fuse.

The box shown in Fig. 2 has three busbars and is intended for three-wire circuits where the neutral cables are brought into the box and connected to a busbar without fuses, while the positive and negative cables are connected through fuses. The positive and negative terminals take cables of any size up to 1,500,000 circ. mils, and the neutral of any size up to 500,000 circ. mils. The terminals and busbars have taper holes for jumper cable the same as the B-2 type. The box may be fitted with stuffing boxes or nozzles, as desired, for the introduction of the cables. They are designed for very heavy service and have the same substantial construction as the box previously described. While intended for three-wire circuits of a maximum potential of 300 volts they may be used for 500-volt systems with grounded neutral by the use of special fuses and the introduction of suitable barriers.

The Tailleur fuse boxes differ from the above types in that all cables enter at the bottom of the box instead of half

Fig. 3—Box at Street Surface.

at each side. Also, the Tailleur type of box may, in the two-wire style, be used with either single or twin cables, and in the three-wire style with either single or triple conductor cables, or part of the cables entering a box may be single conductor and part multiple. They are intended to serve the same general purpose as the M. D. type.

They are manufactured in three sizes, viz., four-way, six-way and ten-way, and each size is manufactured as a two-wire or a three-wire, i. e., with either two or three busbars, as may be specified. The terminals are below the busbars and are connected to it through all-copper fuses. The busbars are offset, the top bar being nearest the back of the box and the lower bars being stepped toward the front of the box, this giving clear space between the bars and insuring that moisture or any fuse metal or loose nut dropping from a bar will fall clear of the others. Busbars and terminals are rigidly supported.

The four-way box is designed to handle main cables only, of sizes up to 750,000 circ. mils. The six-way and ten-way boxes are designed to handle feeder cables of a maximum size of 1,500,000 circ. mils and main cables of 750,000 circ. mils. Provision for pressure wires is made in these two sizes. The box contains a socket wired up for a 110-volt lamp and is fitted with an automatic switch to light it whenever the cover is open. This does away with the use of a lantern in manholes.

Cables enter the box through cast-iron cup glands which are made watertight by means of rubber gaskets and sealed to the cable sheath by filling with hot insulating compound. The cover is fitted with a special molded rubber gasket to make the box tight when closed. The wing bolts and nuts securing the cover are of such a composition that no difficulty will be experienced through rusting.

The cable terminals are soldered on the outside of the box and are fitted with taper plug holes so that a flexible jumper cable or shunt cable can be connected to shunt any fuse and permit of its removal and replacement without interrupting the current on the cable connected to that terminal.

At times manholes of duct systems are inaccessible, due to flooding or to presence of illuminating gas, or a cable burn-out may be in progress. A junction box installed within a manhole under such conditions is inaccessible. The junction box shown in Fig. 3 overcomes this difficulty, for it is accessible at all times and affords the best method of interconnecting cables. The busbars and terminals can be arranged for almost any system of low-tension distribution and for any size and type of cable. Junction boxes of the accessible type have been installed for several years in manholes which are practically always flooded (under the most severe climatic conditions found in the United States) and have operated continuously since installation without trouble of any character.

The box has a strong, cylindrical, cast-iron casing designed to be set in the roof of the manhole. The cables enter the bottom of the box through composition nozzles to which the lead sheaths are united by a wiped solder connection, forming a permanent water-tight and gas-tight joint.

If desired, stuffing boxes may be substituted, doing away with the wiped joint and rendering the boxes suitable for use with unleaded or braided cables.

The busbar and terminal insulation are supported from brackets projecting from the shell of the box, thus providing air insulation between busbars. This allows of radiation from busbars and provides suitable insulation resistance between them. All-copper fuses are used and the arrangement of the box is such that fuses may be removed or renewed with the least

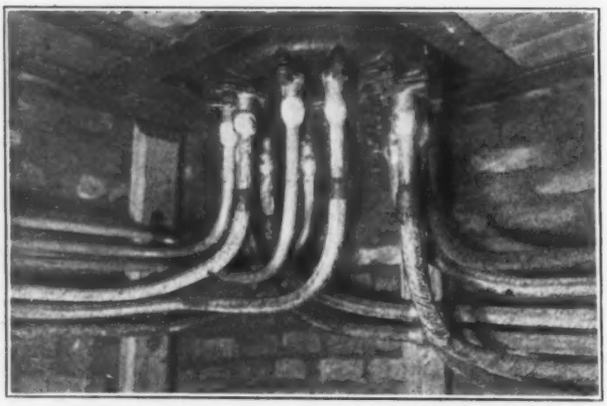


Fig. 4—Bottom of Box Viewed from Manhole Interior.

possible delay. A minimum amount of space is occupied inside the manhole, leaving the interior clear for through cable lines and manhole transformers.

The normal position of the distributing cables is in the upper ducts, so that they may be brought to the junction box without crossing other lines. Entrance nozzles for the cables are made from copper tubing, thus permitting a good wiped joint to be made between nozzle and cable sheath.

The wiped joints unite electrically the lead sheaths of all cables entering the box, and by connecting a single earth bond to the shell of the box all cable sheaths are solidly grounded.

Incombustible shields prevent the arc from a blown fuse making a ground connection to the shell or inner cover.

NEW ENGINEERING LABORATORIES OF THE NATIONAL ELECTRIC LAMP ASSOCIATION.

On the site of the old Brush electrical works, at the corner of Hough Avenue and East Forty-fifth Street (formerly known as Mason and Belden), in Cleveland, is located a new $250,000 three-story building of steel and brick mill construction in which are conducted the central engineering activities of that group of incandescent lamp manufacturers composing the National Electric Lamp Association.

An idea of the exterior architecture will be obtained from Fig. 1, which gives a close view of the East Forty-fifth Street entrance. Each of the big bronze lantern fixtures contains four 60-watt, high-efficiency lamps, which are shown illuminated in a later illustration.

The corridors and offices are all finished with quarter-sawed oak for the doors, ceiling beams, chair rails and other woodwork, as seen in Fig. 2, a view of the front corridor.

The laboratories are finished with hard-pine trimmings, since the liability of damage from movable photometric and electrical apparatus, as well as from chemical reagents, renders the more expensive finish economically undesirable.

An up-to-date time-saving feature possessed by this building, in common with many others, particularly factories, is an automatic call system, worked by the telephone exchange operator. For the purposes of this system the heads of departments are designated by numbers, an electric bell, forming a "station" of the call system, being located in each department. Should a man in charge of a certain branch of the work—for example, the testing—be absent in some other department, the operator may summon him to the 'phone by means of the call system, which automatically rings his number all over the building at regular intervals of time until he responds.

The principal interest in the Engineering Building, from an electrical standpoint, centers about the "burning racks," where lamps are constantly being tested for performance throughout life. These racks are located in a sort of "sky parlor," or glass-inclosed compartment on the roof—a construction which was adopted in order that the streams of radiant energy from

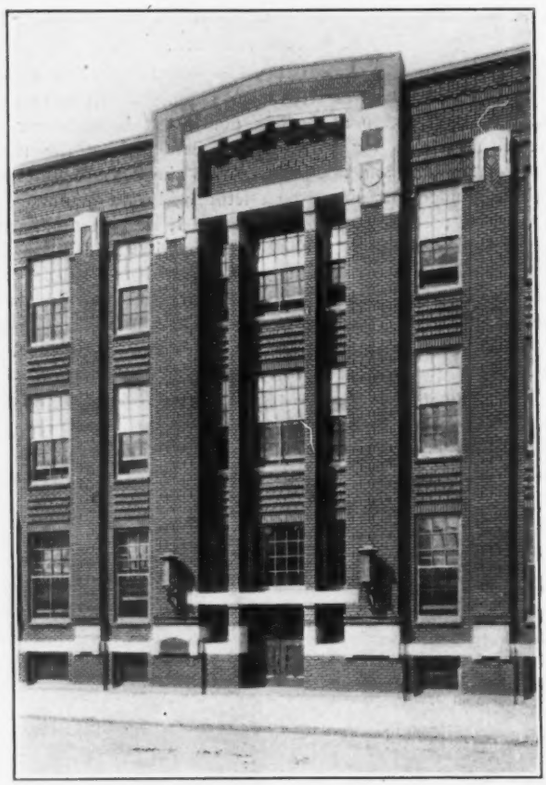


Fig. 1—Portal of Laboratories.

the lamps might pass out of the building with as little previous absorption as possible. At night a spectacle is presented by the blaze of light issuing from the glass-walled rackroom (see Fig. 3). As may easily be imagined, not only are the upper portions of all high structures in the immediate vicinity brightly illuminated by the intense light flux which they intercept, but the rackroom itself becomes a luminous object in the field of vision of observers within a considerable radius of the Engineering Building.

The test racks are operated twenty-four hours a day, seven days in the week. Their purpose is to enable the manufacturers to make sure, by means of actual test results obtained from sample lots of lamps selected every month from their regular output, that quality is being maintained. Also, when changes are contemplated in the construction of lamps or in the composition of their filaments, experimental lamps embodying such changes are here tested in order to determine in what way quality would be affected by the new departure.

Some of the lamps are burned on alternating current and some on direct current. Energy for the alternating-current racks is transmitted through small air-cooled compensators, of which there are 1000. The different transformation ratios of

these compensators furnish the requisite means for obtaining any desired voltage at lamp terminals, while a Tirrill regulator prevents the pressure from varying more than a fifth of 1 per cent above or below normal, barring accidents or shutdowns. Thus the lamps are tested under as rigidly maintained conditions as have hitherto been found practicable or necessary for this sort of work when conducted as a commercial proposition

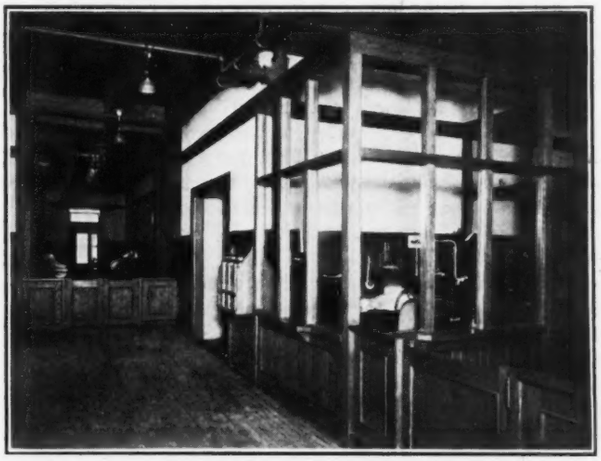


Fig. 2—Entrance Hall.

for a group of manufacturers. While such close voltage regulation would be unnecessary on central-station circuits, its desirability is obvious in engineering tests the results of which are used as a numerical indication of lamp quality. Over 400 tests are perpetually on the racks, a "test" consisting of from one to ten lamps of the same type, which are being subjected to the same conditions for the purpose of determining their average performance under these conditions. Over 4000 candle-power measurements are made every week to determine the variation of light intensity with time, a large part of the floor space of the engineering department being occupied by the apparatus necessary for making these and other photometric measurements. The electric generating, or rather converting, equipment with its control apparatus, including a 40-ft. switchboard, is located in the basement.

When the fact is considered that there are four distinct

Fig. 3—Inadequate Representation of Roof Night Spectacle.

classes of incandescent lamps in extensive commercial use today, two of these classes having carbon and the other two having metal filaments, and that these are further subdivided into more than 400 distinct types designed for nearly every class of lighting service, the engineering problems connected with the maintaining of present quality loom up almost as large as those connected with development work the purpose of which is to secure progressive improvement of quality. In this connection some data regarding the size of the Engineering Building will be of interest. Its length is 265 ft.; its width, 122 ft., and its height, exclusive of the rackroom on the roof, is 60 ft.; thus the volume is 1,940,000 cu. ft. In order to build a solid pile of this same size, to consist of wooden standard package boxes such as are used for the shipment of 40-watt, high-efficiency lamps by the member companies, 257,600 such boxes, representing 25,760,000 lamps, would be required. It is interesting to note that even this formidable figure is many millions less than half the total number of incandescent electric lamps of all types made and sold in the United States in a single year.

STERILIZATION OF WATER ON A LARGE SCALE BY MEANS OF ULTRA-VIOLET RAYS.

There are two problems of industrial water sterilization. The first one consists of obtaining water perfectly free from germs, that is to say, absolutely sterile. The second problem is that of obtaining water which is good for public distribution as drinking water and does not present any danger of acting as propagator for infectious maladies which, according to modern hygienic theories, are likely to be spread by certain microbes living in the water. Typhoid fever and cholera, which are supposed to be propagated by water, may be mentioned particularly.

It has been frequently demonstrated that sterilization by means of ultra-violet rays is not only safe but also much simpler and cheaper than by other methods. The quartz-tube mercury-

Fig. 1—Sterilizer.

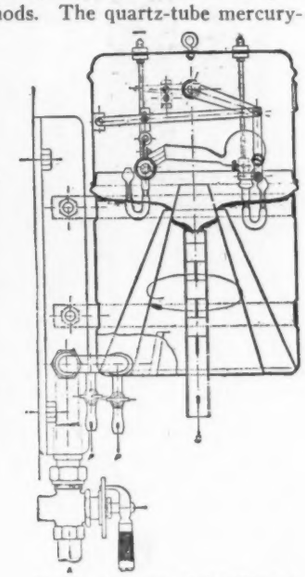


Fig. 2—Section of Sterilizer.

vapor lamp represents the first really convenient source of ultra-violet rays. The mercury arc has been studied particularly by Arons and by Mr. Peter Cooper Hewitt, the latter's work resulting in the development of the Cooper Hewitt mercury-vapor lamp. An advance was made in the design of mercury-vapor lamps when Schattner and Kuech inclosed the mercury arc in tubes of fused rock crystal whereby they obtained a very strong source of ultra-violet rays. The presence of these rays was, however, a disadvantage for an illuminating lamp, the rays themselves being injurious to the eyes. The tube of the Cooper Hewitt lamp is manufactured of glass, which is an absorbent of the ultra-violet rays which are produced in the interior of the tube. It is on this account that the light obtained from the glass-tube lamps is in no way harmful.

Quartz-tube mercury-vapor tubes were first applied exclusively to illuminating lamps, the tubes being inclosed in glass

globes so as to protect the public against the ultra-violet rays which pass through the fused rock crystal of which the tubes themselves are made. Such quartz mercury-vapor lamps are being made at the present time by the Westinghouse-Cooper Hewitt Company in London and Paris and by the Quartzlampen Gesellschaft in Hanau. The former company has studied jointly with Messrs. von Recklinghausen, Henri and Helbronner the application of this mercury-vapor lamp (known as the silica lamp) to other than illuminating purposes. These studies began with the particular application of the ultra-violet rays to the sterilization of milk and water. This work has since been taken up in a good many other laboratories, it now being a matter of almost general knowledge that dangerous microbes contained in water are killed with quite remarkable speed by the means of the ultra-violet rays emitted. The work done in this matter has enabled the Westinghouse-Cooper Hewitt Company to produce water-sterilizing apparatus for different applications.

The first apparatus developed gives a continuous supply of sterile water at the rate of 130 gal. per hour, such quantity being quite sufficient for most medical uses. The normal illuminating lamp consuming 3.5 amp at 110 volts is suspended in the apparatus immediately above the surface of the water. The apparatus itself is enameled white, this finish inside having a

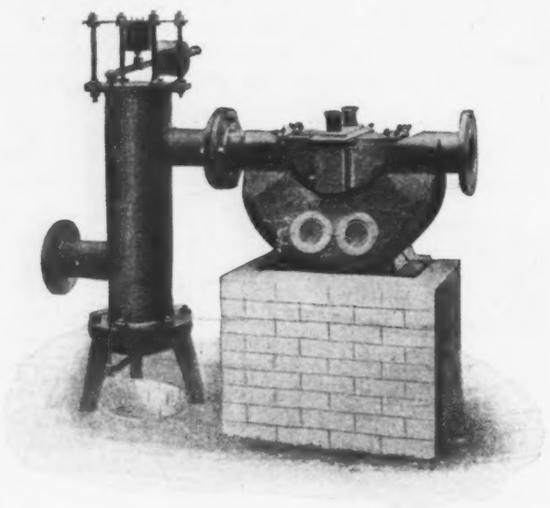


Fig. 3—Large Water Sterilizer.

good reflection coefficient, thereby increasing the efficiency.

The water in the apparatus is under violent agitation and is exposed for about five minutes to the influence of the rays from the lamp. The water is agitated by passing it through conical baffles which are placed inside the apparatus for submitting every particle of the water to the influence of the rays.

Another apparatus producing about the same quantity of sterilized water has been put on the market. But this operates differently in that the lamp is submerged, it being claimed that a greater number of rays emitted by the lamp are utilized for the purpose of sterilization. However, the normal working of the lamp is modified by the chilling effect of the water, so that there is a lower production of rays. The chief disadvantage, however, is that the luminous tube becomes gradually coated with scale from the salts contained in the water, which scale renders opaque the otherwise transparent tube and prevents the ultra-violet rays from entering the water, in consequence of which sterilization is arrested.

The sterilization of large quantities of drinking water for public water distribution has been the object of numerous tests. Experiments to test the efficiency of the apparatus for this purpose were made by artificially polluting the water which entered the apparatus. The lamps were suspended above the water, being maintained at a short distance from the surface by means of floats. These experiments also showed in a striking manner the importance of having the water violently agitated and this experience has been used in the construction of new apparatus. The early experiments showed that sufficient sterilization of drinking water could be obtained with an expenditure of 36 watt-hours per cubic meter.

For the efficient operation of the quartz lamp it is necessary that the luminous tube should be at a high temperature (about 800 deg. C.). If the lamp is artificially cooled either wholly or in part as is the case when it is submerged in running water such a high temperature cannot be obtained and the light efficiency of the lamp is seriously reduced.

For dealing with water sterilization on an industrial scale the Westinghouse-Cooper Hewitt Company has developed a single unit, such as is shown in Figs. 3 and 4, one or several of which may be set up according to the quantity of water demanded. This unit will sterilize at least 600 cu. m (132,000 gal.) in twenty-four hours and is fitted with one 3-amp, 220-volt lamp.

The unit consists essentially of three parts, namely, a cast-iron chamber in which the water comes under the influence of the ultra-violet rays; a box with cut-rock-crystal windows into which the lamp is fitted, and an automatic deviating valve which insures that no water shall pass through the sterilizing chamber at such times as the lamp is not in operation.

The chamber *E* through which the water passes is fitted with several baffles for directing the flow. These serve the purpose of stirring up the water, which, as already pointed out, is necessary for the proper treatment and brings the full quantity of water under the direct influence of the light on three distinct occasions.

The lamp box *I* makes a water-tight joint with the containing vessel *E*, being held in position by means of four bolts with

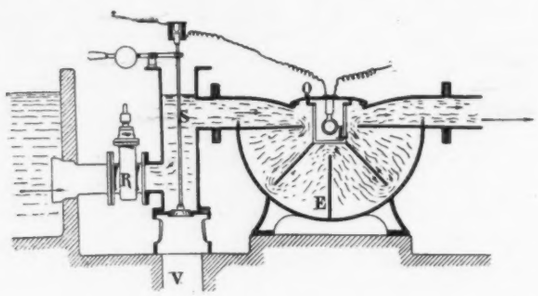


Fig. 4—Section of Water Sterilizer.

wing nuts, the box itself forming an obstacle in the path of the water. The three sides of this box in the path of the water are fitted with windows of cut rock crystal, which provide free passage to the ultra-violet rays emitted by the lamp through which they pass into the water flowing in the chamber.

The deviating valve *V* is placed between the supply and the sterilizer apparatus and consists of a double-T piece fitted with a mushroom valve at the lower end, this valve being held closed by means of a solenoid energized by the current in the sterilizing lamp. Should the current be cut off for any purpose this valve would be immediately opened and the water would cease to pass through the sterilizing chamber.

On entering the apparatus the water passes through the supply valve and over the deviating valve *V* into the chamber *E*. The flow as directed against the first window of box *I* by means of a baffle is then sent to the periphery of the chamber and back again to the second or horizontal window; thence it passes back to the periphery of the chamber, round further baffle to the third window, thus coming under the direct influence of the ultra-violet rays on three distinct occasions.

In the event of the lamp not being in operation the deviating valve *V* would be open, through which the water would pass; in this way it is assured that nothing but sterilized water can be distributed to mains.

A Westinghouse sterilizer of this type has been in service for a considerable time at the Competitive Exhibition for Sterilizing Apparatus at Marseilles.

Tests with this apparatus have shown that with water passing through the apparatus at the rate of more than 600 cu. m per twenty-four hours and a consumption of less than 26 watt-hours per cubic meter the water leaving the apparatus was in the majority of cases absolutely sterile—that is, it showed an entire absence of germs—and in no case did tests reveal more than ten germs per cubic centimeter. The water which has been treated in apparatus of this description can, therefore, be safely classified among the "perfect" waters, although water which was fed into the apparatus could scarcely be called potable, it being far too rich in coli bacteria.

The above tests, which were carried out by independent authority, have demonstrated the possibility of producing perfect drinking water for public distribution with a consumption of 26 watt-hours per cubic meter in single apparatus capable of dealing with fully 600 cu. m in twenty-four hours.

THE FLAME-ARC LAMP IN GREAT BRITAIN.

By J. A. Seager.

Within a recent period the electric arc lamp has not been sufficiently appreciated as an illuminant by those whose duty it is to mark the progress of illumination matters, and this is possibly due to the fact that the metal-filament lamp has made such phenomenal strides that problems of technical and financial importance with regard to this mode of illumination have occupied attention, leaving the older means of lighting comparatively unnoticed.

At the same time there has been in Great Britain a very strong movement in favor of the increased adoption of electric arc lighting, particularly in cases where large spaces can be illuminated from points comparatively distant from one another.

It is not proposed in this article to go very exhaustively into the question of the different types of mechanism adopted in the arc lamps at present on the British market, but rather to deal with the question from a general point of view in order to show the lines on which, given certain apparatus for producing light, the capabilities of this apparatus and the conditions required by the consumer have been co-ordinated. The first and most important feature of recent progress has been the recognition, practically universally, of the principles of scientific illumination, and in this the Illuminating Engineering Society of Great Britain has been very largely instrumental. From considerations of the distribution of illumination and the requirements of a good illumination in streets, factories and workshops, the arc lamp has been demonstrated to be a most useful means of general illumination, and considerable progress has been made in dispelling the idea that owing to the high candle-power of each unit and the consequent wide spacing of the lamps a largely uneven distribution of lighting would be obtained as compared with gas lamps. This particular cry was most energetically raised a year or two ago by the gas interests in Great Britain, and for some time carried a certain amount of weight in municipal undertakings, but the actual results in streets illuminated by means of arc lamps were quite sufficient to demonstrate their superiority, particularly where flame arcs were employed. As an interesting example of the way in which arc lighting has been adopted in the crowded London streets Fig. 1 shows the use of the Oriflamme arc lamp in Cannon Street, London. It will be seen that in place of the usual post a method of suspension from side to side of the street has been adopted without forming any obstruction to vehicular traffic. The number of important thoroughfares, both in the metropolis and in provincial towns in Great Britain, illuminated by flame-arc lamps can, of course, be reckoned in thousands at the present date, and a large proportion of this success is due to the adoption of the flame-arc lamp combined with the adequate perception of the value of reflecting surfaces in spreading illumination over a wide area.

Fig. 1—Arc Lighting of Cannon Street, London.

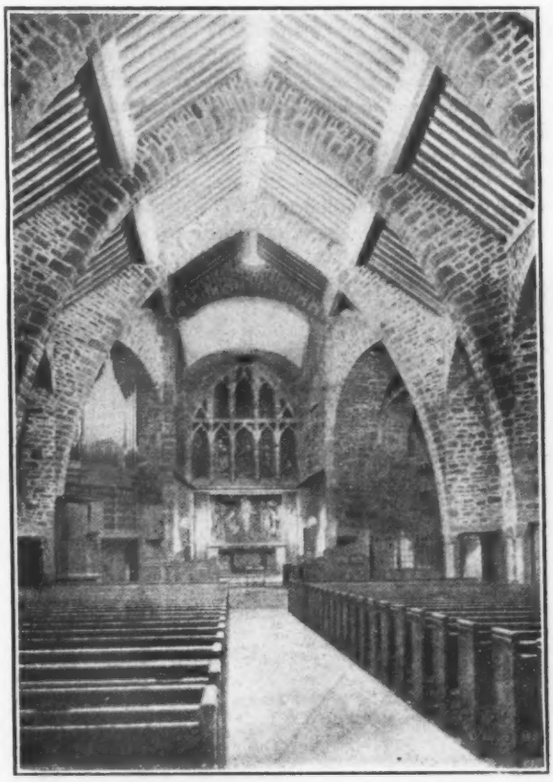


Fig. 2—Arc Lighting in Church in Sunderland.

The development of the flame-arc lamp since its very earliest days is by no means an uninteresting subject in this connection, this interest being increased by the fact that the development of the lamp has been more than usually rapid. In the early days the flame arc was always unsteady, the deposit was a drawback and retrimming was a constant necessity. This latter fact made its employment a nuisance inside buildings, while it practically could not be used in the streets, as the average winter's night was longer than the life of one pair of electrodes. Various ingenious methods of getting over this difficulty have been designed and put on the British market.

One method adopted for overcoming the inherent short life of the flame arc consists in the use of four electrodes placed

side by side and molded in one piece. This forms a plate of carbon and when fixed in position in the lamp makes with its extra pair two electrodes of four times the ordinary width. When the lamp is switched in circuit it is found that the arc strikes across the whole of the ends of the carbon plates, but almost immediately becomes confined to one particular point. As the carbon burns away the arc shifts to another point of less resistance and continues to do so in a forward and backward motion, gradually and evenly consuming the electrodes. In this way a total life of forty to fifty hours is obtained at one trimming without the lamp being extinguished as each pair of carbons comes into action, as is usual in most magazine lamps. This particular lamp exemplifies the type of developments which is now taking place in order to make the flame-arc lamp equivalent in long-hour capacity to the older form of lighting.

Reference was made above to the question of the deposit obtained from flame-arc lamp carbons, which for a long time presented a very serious difficulty. The deposit caused by the use of impregnated carbons usually settles on the globe of the lamp in a very adherent form, and in one design an inner and outer globe are provided connected together at the top by a diaphragm, an inclosed air space thus being formed between the two globes. In the outer of the two is an ashtray through which air enters. The air is slightly heated in the space between the two globes, and, the inner globe being open at the bottom, the heated air rises upward to the arc. After being charged with the fumes and deposit from the arc it is then deflected sidewise toward the inner surface of the inner globe. As this is strongly heated, no deposit takes place, as the charged air is not cooled and the course of the air is maintained upward through the lamp, both the inner and outer globes being kept free from the deposit. The ashtray also acts as a wind trap, preventing any reversal of air current inside the globes even in a high wind. In the latest form of Excello lamp the inner globe is adapted so as to have dioptric or prism qualities in order to deflect the rays of light in a more horizontal direction than they would otherwise assume and thus spread the illumination over a large area. The effect of this is a magnificently uniform sheet of light, which has found very great favor both for public and private installations in Great Britain.

Fig. 2 shows the way in which it has become possible to utilize arc lamps even in interiors under most stringent conditions, this showing flame-arc lamps in an Anglican church in Sunderland. This innovation may be held to be a novel field for arc lighting in connection with interiors. Incidentally this disposes of the very greatly exaggerated statements which have been made with regard to the poisonous gases generated by the impregnated carbons.

Another feature with regard to recent developments of flame-arc-lamp lighting in Great Britain is the recognition that one type of lamp is not suitable for every possible position and situation. This became apparent even in outdoor lighting when the flame-arc lamp was used not only for the illumination of thoroughfares from the height of a lamp-post, but also for advertising display purposes outside shop windows. In the London metropolitan area the disadvantage of having lamps of high candle-power suspended so close to the pavement and in a position such as to dazzle pedestrians caused the authorities to issue restrictions regarding the use of such lamps, and it has been generally found that a smaller candle-power flame lamp is desirable for such purposes. Their use has also brought about a demand for a more ornamental type of lamp, and it may generally be said that present-day designs are far in advance of the early type of flame lamps as regards decorative features.

Reverting to the question of outside lighting, more particularly in front of shop windows, a very notable factor of this development is the considerable attention which has been paid to shortening the over-all dimensions of the lamps. Formerly the chief aim of the designer was to offer facilities for as great a length of carbon rod as could be used conveniently in order to reduce the number of trimmings as far as possible, but the use of lamps in low situations has brought about a demand

Fig. 3—Restaurant Lighting.

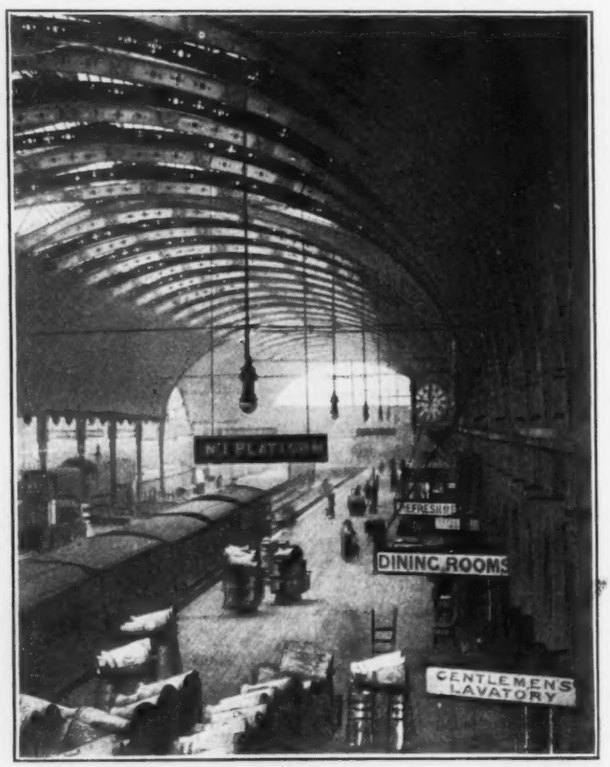


Fig. 4—Train-Shed Lighting.

for a lamp which when suspended from a bracket placed on or above the ordinary shop-window level will yet hold the actual flame at a sufficient distance above the heads of pedestrians and their umbrellas. These conditions have now been very largely complied with, and the result is a sweeping adoption of flame-arc-lamp lighting for the exterior illumination of shops and

Fig. 5—Factory Lighting.

business premises. Fig. 3 shows a view of the Corner House, Piccadilly, a well-known London restaurant, which is lighted outside by means of flame-arc lamps of the Angold type and by tungsten lamps within. This restaurant is one of the most brilliantly lighted in London, and would compare favorably in this respect with any elsewhere.

Another indication of the adaptation of means to a definite end is the modification which has been made both as regards types of reflectors and composition of electrodes for interior lighting. One of the latest features in the large depart-

Fig. 6—Factory Lighting.

ment stores, for example, in Great Britain is the use of the inverted pattern of reflector for throwing the rays of light upward on the white surface of a ceiling, giving as a result a beautifully subdued light with practically an entire absence of shadow. This has been used both with the ordinary open type or inclosed type of arc lamp and also with flame-arc lamps with very good effects, not only in shops, but also in such industrial locations as works' drawing offices, etc., and this method of lighting is becoming rapidly extended at the present time. Numerous attempts have also been made to eliminate the extreme redness of the flame-arc-lamp rays by the preparation of special electrodes giving a very light orange color and in some cases pure white. These electrodes are, of course, more expensive than the ordinary type, and the pure white carbon has been adopted in a good many cases, such as in drapery establishments where color-matching properties have been desired.

Reference has not yet been made in detail to an extremely important sphere of development of the flame-arc lamp in Great Britain in connection with industrial establishments. It is hardly surprising that it has met with such wide appreciation in this connection, inasmuch as there is no doubt of its value in illuminating machine shop bays, railway yards, wharves and

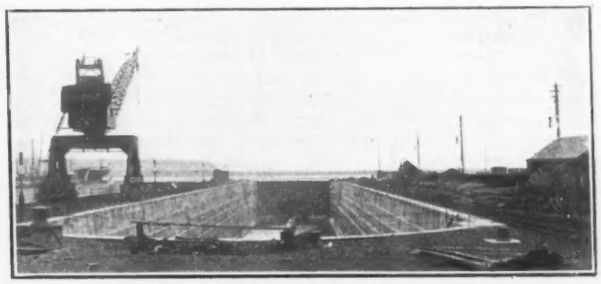


Fig. 7—Dock Lighting.

similar situations. Little, therefore, need be said on this subject beyond drawing attention to certain typical installations of this nature. Fig. 4 shows the use of Oriflamme flame-arc lamps at the Paddington terminal station of the Great Western Railway in London. It is not beside the mark to say that this illumination was secured only after a spirited contest with the rival form of lighting by means of gas lamps. Figs. 5 and 6 show the lighting effects of Westinghouse Arcturus flame lamps at the Challenge Cycle Works, at Coventry, and show the applicability of this form of lighting to fitting shops and small repetition work generally. Figs. 7 and 8 are taken from the newly completed docks at Middlesborough. The former view shows the dock itself lighted by means of sixteen Westinghouse direct-current flame-arc lamps, while the latter shows the workshops attached to the dock lighted by eight similar lamps. These illustrations give a sufficiently varied indication

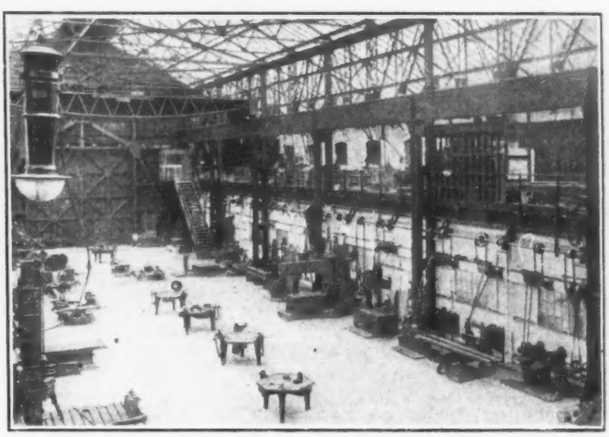


Fig. 8—Dock Lighting.

of the way in which flame-arc lighting is being adopted for industrial purposes in Great Britain. Enough has been said to make it apparent that the flame-arc lamp has been thoroughly tested and tried in a great many different spheres and over a period of time. The results of experience in this form of illuminant show that, although much can be done with the older forms of arc-lamp lighting, the true solution of the problem of illumination over wide spaces undoubtedly rests with the flame-arc lamp.

Industrial and Commercial News

The Week in Trade.

DEMAND for holiday goods is growing more prominent, and the development in this respect is about the only encouraging feature in the present condition of trade. Outside of this movement, trade continues to be irregular and in many respects unsatisfactory. Re-orders among the wholesalers and jobbers are rather scarce and not up to the average for the season. In addition to this, reports from retailers indicate somewhat less activity. The most encouraging reports last week came from the South, where the good movement of cotton at high prices has done something to stimulate buying. In the Northwest, save in North Dakota, where crops were short, the trade is fair. In the East and in the New England states the condition is distinctly disappointing. Among the manufacturing concerns the electrical companies all report fair business, and the wire manufacturers are also well supplied with orders. Aside from these two branches, the industrial world is rather dull. Quieter conditions have developed in markets for iron and steel, and the situation is not apparently so encouraging as when the reports for last week were made. The tonnage for railway equipment is not coming out as actively as was anticipated, and the railroads are spreading their orders over a longer period than was at first expected. It is said that some good-sized contracts for structural material are pending in the West, but these have not yet been placed. One leading producer of this class of material has reduced prices, and it is believed that manufacturers generally will make concessions in order to secure business. Negotiations for considerable quantities of steel rails are said to be pending, but they have not yet taken the form of definite contracts. It is said that one leading railroad has prepared specifications for 300 locomotives, and that the order will be placed within a few days. No orders for cars to any considerable amount have been placed within the past week. One bright spot in the situation is the fact that the lowering of commodity prices has stimulated export trade to a considerable extent, and has led producers to believe that after the beginning of the new year exports will largely increase. Collections are still rather slow, but of this little complaint is made. Business failures for the week which ended Nov. 24, as reported by *Bradstreet's*, were 212, as against 248 the previous week, 217 in the same week in 1909, 193 in 1908, 258 in 1907 and 174 in 1906.

The Copper Market.

COPPER prices closed last week a trifle higher than at the close of the week previous. The entire sentiment of the copper market may be pronounced as stronger, and the condition is somewhat improved. The sales of the week have not been particularly large, but there is a general belief that heavy consumers will soon be compelled to come into the market for substantial quantities. It is pointed out that all of the electrical companies which are large consumers of copper have recorded during the present year increases in their business. These increases taken together indicate about a 20 per cent growth in the domestic demand for copper. Under such circumstances present stocks held by consumers will not last very long, and if business after the first of the year shows signs of improving, it will be necessary for purchases of metal to be made. Another feature which has to some extent strengthened the market is the renewal of amalgamation rumors which practically sustained prices last winter and spring. There is also a great deal being said by producers concerning the effect of the curtailment policy, which it is now claimed has been operative long enough to show in the statistics of the Copper Producers' Association. All of these things have improved the tone of the copper market and slightly advanced prices, but have not brought about any very heavy sales. Imports continue to run at about the same figures as during the past three months. Exports are a trifle heavier, and since Nov. 1, including Nov. 28, have amounted to 24,974 tons. The daily call on the Metal Exchange Nov. 28 quoted standard copper as per the accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	12.45	12.60	.....
November	12.45	12.60	12.52½
December	12.45	12.60	12.52½
January	12.50	12.65	12.57½
February	12.55	12.70	12.62½
March	12.60	12.80	12.70

The London market, Nov. 28, was as follows:

	Noon. £ s d	Closing £ s d
Standard copper, spot	57 15 0	57 8 9
Standard copper, futures	58 13 9	58 7 6

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	13.50c	11.70c
London, spot	£62 0 0	£52 15 6
London, futures	65 18 0	53 7 6
Best selected	65 10 0	57 15 0

Industrial and Commercial Notes.

Equipment Ordered by the New York Edison Company.—The General Electric Company has taken an order from the New York Edison Company for quite an important amount of equipment. The order includes three 20,000-kw vertical steam turbo-alternators, four 2500-kw rotary converters with statics and regulators, three 3000-kw, 3-phase, air-blast transformers, one 375-kw regulator, three 300-kw generator sets and a large equipment of high-tension oil switches, instruments and switchboards. The three 20,000-kw turbines are to be placed in Waterside Station No. 1 to replace four 4000-kw steam engine-driven units. The four units which are to be replaced are a part of the eleven units which were installed when this station was built. It is explained by an official of the New York Edison Company that this change is made in order to utilize the excess of boiler capacity which was installed in this station. By the substitution of these large turbines the total capacity of the station will be increased 44,000 kw without additional cost of buildings or boilers. The engine-driven units have proved entirely satisfactory, and are only replaced by the turbines in order to utilize the extra boiler capacity that is already installed. Deliveries of this apparatus will be made next year, beginning in the spring. The four 4000-kw units which have been taken out of the station were sold by the Edison Company to the John A. Stewart Electric Company, of Cincinnati, Ohio.

Transmission Lines for Sonora Mines.—The Central Mexico Light & Power Company, a subsidiary of the Guanajuato Power & Electric Company, has just completed a transmission line from its distributing station at Guanajuato to San Luis Potosi, a distance of 89 miles. The distance from Guanajuato to the generating plant in the State of Michocan makes the total transmission distance about 200 miles. The Central company purchased some months ago the lighting and distributing system of San Luis Potosi for $700,000. The large smelter belonging to Robert S. Towne will become a customer of the company and a number of mines in the San Pedro district will also receive energy from the new transmission lines. The Mexican government has recently granted a concession for a transmission line from the Copper Queen smelter at Douglas, Ariz., to the El Tigre mining district in Sonora.

American Carbon & Battery Company.—The American Carbon & Battery Company, of East St. Louis, Ill., has recently purchased the plant and business of the Doe Battery & Manufacturing Company, of Kent, Ohio, and will continue the manufacture of the dry cells made by the latter in connection with its own carbon and graphite products. The American company is in a favorable position to manufacture high-class dry cells owing to its close identification with battery work in manufacturing carbon elements. The dry cell now made by the company is known as the "American," and is put forth as representing several improvements over the "Victor" cell, made by the Doe company. Descriptive literature of the several types of "American" cells is furnished on request.

Fourteen-Thousand-kw Turbines for Milwaukee.—The Milwaukee Electric Railway & Light Company is installing two 14,000-kw and two 7500-kw Curtis turbo-generator sets in its Commerce Street station, which already had an existing equipment of 20,000 kw. Other important additions to the boiler and auxiliary equipment are being made at this plant.

General Electric Company's Business.—During the past week there has been a rapid advance in the price of General Electric Company's stock upon the New York Exchange. This movement, it is said, has been based upon the earnings in the current year and the prospective business for the next year. It has been accompanied by reports that the directors would be justified in raising the dividend rate. It is not likely, however, that anything will be done in this direction within the next six months. The General Electric Company on June 1 of next year will redeem $13,000,000 of 5 per cent bonds at par and 5 per cent premium. The holders of these bonds have the right to convert them into stock at par. The sales billed by the company for the year, it is said, will be close to $70,000,000, which is compared with $51,656,000 for the eleven months which ended Dec. 31, 1909. The net earnings for 1910 should be in the neighborhood of $8,400,000, which is equivalent to about 13 per cent on the stock. The growth of the company's business in the current year has not been due to large contracts received, but to the great increase in small orders. There has been a notable absence of large railroad and traction company orders. Should there be a revival of business of this character the plants of the General Electric Company, as well as other large electric companies, would hardly be able to supply the demand. While the business of the company for the current year will be practically as large as the best year in its history, the plants will not be operated at anything like full capacity. It is estimated that the company at the present time is able to take care of a business amounting to $100,000,000.

Allis-Chalmers Business.—The bookings of the Allis-Chalmers Company for the first two weeks of November, while not up to the same period of 1909, showed some improvement over October, and inquiries received indicate an upward trend in the demand for most lines of machinery. In one day last week the company closed contracts for crushing machinery for prompt delivery aggregating upward of $250,000. This shows an extraordinary demand for this line at this season, as the orders are usually placed in the spring. The record for the current fiscal year of the company is somewhat below that for the corresponding period of last year. July was the best month in the history of the company, but after that time there was a considerable decline in orders. Since April 1 the operations of the company's plants have been about on a level with 1907, but as a result of extensions made during the past three years the total capacity has been increased something like 25 per cent, so that, while the output for the past six months has been comparatively normal, the plants have been operated at only about 75 per cent of capacity.

The Jandus Electric Company Sold to Adams-Bagnall Electric Company.—The Adams-Bagnall Electric Company, of Cleveland, Ohio, has purchased the good will and assets of the Jandus Electric Company, of the same city, and will continue the manufacture of Jandus products, which will be marketed under the trade name "Jandus," as, for example, Jandus fans, Jandus luxolabra, etc. The Adams-Bagnall Electric Company has associated with it the former management of both the commercial and engineering departments of the Jandus company. With largely increased capital and greatly extended facilities, it is the purpose of the combination to insure improved service both to the former patrons of the Jandus company and the Adams-Bagnall company. The Jandus company has had a long and useful career, and while it will be missed from the field as a separate organization, it is gratifying to know that its work will be continued under most efficient conditions in the new combination.

Copper Consolidation Talk.—The copper market during the past week has been well supplied with rumors concerning the impending consolidation of great interests in the copper industry. No official announcement bearing on the subject has been made, but in a general way it is understood that the proposed merger will embrace properties in widely separated camps, and that there will eventually be organized a holding company of the type of the United States Steel Corporation, which will be designed to bring the bulk of the American copper output under one control. It is said that a conference of leading copper men was held in New York last week, at which the outline of such a combination was agreed upon. John D. Ryan, president of the Amalgamated Copper Company, is named as the active spirit in bringing about this consolidation. Although the Calumet & Hecla interests were mentioned in this connecton, an official of that company declares that it is not either directly or indirectly interested in any consolidation, and that there is no truth in the report so far as that company is concerned.

Pennsylvania Water & Power Company.—The total cost of the hydroelectric development of the Pennsylvania Water & Power Company at McCall's Ferry, on the Susquehanna River, up to the time of turning on power in October, has been $13,000,000. The Oct. 20 issue of the *Electrical World* contained a description of the plant and of the beginning of operations with two large generating units. This estimate of cost includes the transmission lines into Baltimore, which were constructed by the Susquehanna Transmission Company of Pennsylvania and the Susquehanna Transmission Company of Maryland. It also includes the cost of the substation in Baltimore. The officials of the company state that as fast as the generating apparatus can be delivered the additional units will be installed. It is expected to have five of these in operation by next spring.

Decision Against Independent Telephone.—The Appellate Division of the Supreme Court of New York City has affirmed the decision of the lower court denying the application of the New York Electric Lines Company for a mandamus compelling the Empire City Subway Company to grant space in its conduits for the plaintiff's wires. The ground upon which the decision is based is that the permission to operate telegraph and telephone wires in New York City claimed by the Electric Lines Company has been rescinded and did not at any time amount to a franchise. The Electric Lines Company is the wire-leasing corporation in connection with which the Great Eastern Telephone Company was planning to operate an independent system in New York City.

Stave Electrical Company.—A recently patented 150-hour flaming-arc lamp will shortly be placed upon the market by the Stave Electrical Company, 27 West Twenty-seventh Street, New York. When in Germany last September Theodore Stave, president of the company, secured the American rights to this lamp, which, it is claimed, will make street lighting by flame arcs sufficiently economical to be attractive. A project is on foot for the manufacture of these lamps in this country. The Stave company has recently taken quite a number of large contracts for flaming-arc installations. Among these are large orders from the General Motors Company and the Lozier Automobile Company.

Grenagle Electric Company.—Stockholders of the Grenagle Electric Company have voted to increase the authorized capital stock of the corporation from $50,000 to $75,000. The company has patented a new incandescent lamp which is intended to reduce the cost of illumination. James B. Grenagle, the president of the company, is the inventor. The company has its plant in Baltimore, but additional money was needed for the installation of new machinery. A portion of the additional $25,000 authorized stock issue will be sold to provide funds to equip the plant further.

Westinghouse Motors.—The Westinghouse Electric & Manufacturing Company has recently booked several large orders for small power motors. These include 1000 graphophone motors for the American Graphophone Company, 500 ¼-hp special alternating-current motors for the Electric Renovator Manufacturing Company, 500 ⅛-hp, 110-volt, 60-cycle motors for the 1900 Washer Company, 450 1-15-hp motors for the Wayne Manufacturing Company and 624 ½-hp alternating-current motors for the Hobart Electric Company, of Troy, Ohio.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions to present plants at Milwaukee, Wis.; Sherbrooke, Que., Can.; Clarion, Pa.; Jackson, Ohio; Albany N. Y.; Hagerstown, Md.; Black Mountain, N. C.; Grapeland, Tex.; Lovell, Wyo.; Mitchell, Ont., Can.; Valders, Wis.; Endeavor, Wis.; Duluth, Minn.; Garfield, N. J.; Orono, Maine; Rock Hill, S. C., and Prince Rupert, B. C., Can.

Allis-Chalmers Turbine for Madison (Wis.) Plant.—The Madison Gas & Electric Company has made additions to its electric plant amounting to $60,000, including two Sterling boilers of 500 hp each and a 1000-kw Allis-Chalmers turbo-generator with condenser. Automatic stokers have been installed under the boilers.

Financial.

The Week in Wall Street.

IT WOULD be hard to imagine a Wall Street market that was less interesting or duller than that of last week. The Thanksgiving holiday was made the occasion for many of the regular traders to withdraw from the market, and on Friday and Saturday following the holiday the Street was almost deserted. The activities of professional traders have been much curtailed of late, and there seems to be practically no outside investment in the market and very little interest taken by the general public. The first break in this condition of apathy occurred Nov. 28, when there was an active selling movement and a sharp break. This was attributed to the pessimistic utterances of James J. Hill. At one time immediately succeeding the election it became apparent that the market had been oversold and that the short interest was considerable. This was responsible for the sharp decline which occurred at this time. It is now generally known that this short interest has been pretty thoroughly eliminated, and that there are not a great number of accounts being carried on either side of the market. One of the features of last week's transactions was the sharp advance which occurred in General Electric stock. Trading was more active in this issue than it has been for many weeks, and the advance was accompanied by reports of large earnings and a possible increase in the dividend rate. While there is much uncertainty felt in Wall Street as to the future of the market, the more hopeful of the traders are still predicting a December advance. It is not quite clear on what basis this prediction is placed. During the past week there have been large supplies of money placed at the command of Wall Street borrowers, but the demand has not been particularly active. Rates for call money are particularly low, and rates for time money are as easy as usual at this season of the year. Quotations Nov. 28 were: Call, 2¼ @ 2½ per cent; 90 days, 5 @ 5½ per cent. The quotations in the table are those of the close Nov. 28.

NEW YORK.

	Nov. 21.	Nov. 28.	Shares Sold.		Nov. 21.	Nov. 28.	Shares Sold.
All.-Ch.	9⅞*	9⅞*	———	Int.-Met., pf.	112½	52¾	4,880
All. Ch., pfd	32	33	200	Mackay Cos.	95½	92⅝*	100
Amal. Cop.	69½	67	29,600	Mackay C., pf.	74½*	75*	100
Am. D. T.	20½*	20½*	———	Man. Elev.	141½	140	100
Am. Loco.	40	37¾	2,550	Met. St. Ry.	15*	15*	———
Am. Loco., pf.	106¾*	106¾*	100	N.Y.&N.J.Tel.	139¼*	139¼	———
Am. Tel. & C.	84*	84*	———	Steel, com.	80	76⅝	307,950
Am. T. & T.	142½*	140¾	10,350	Steel, pfd.	118½	117¼	5,052
B. R. T.	78	75⅜	14,850	W. U. T.	72¾	71	800
Gen. Elec.	156¼	157¼	11,300	West'h, com.	71⅜	68¼	6,800
Int.-Met.	20⅞	19⅛	5,300	West'h, pfd.	124*	123*	100

PHILADELPHIA.

	Nov. 21.	Nov. 28.		Nov. 21.	Nov. 28.
Am. Rys.	43	43*	Phila. Elec.	15⅞	15½
Elec. Co. of A.	11¾*	11¾*	Phila. R. T.	17⅜	18⅛
Elec. St. B'ty	48	48	Phila. Trac.	83*	83
E. S. B'ty, pfd.	30*	30*	Union Trac.	41½	43⅛

CHICAGO.

	Nov. 21.	Nov. 28.		Nov. 21.	Nov. 28.
Chi. City Ry.	170*	170*	Chi. Tel. Co.	123*	123
Chi. Rs., Ser. 1	82½	91	Met. El. Co.	21*	20
Chi. Rs., Ser. 2	22¾	25¼	Met. El., pfd.	62	65
Com. Edison	115½	116	Nat'l Car	125*	123
Chi. Subways	4⅞*	4½	Nat'l Car, pfd.	118¾	119*

BOSTON.

	Nov. 21.	Nov. 28.		Nov. 21.	Nov. 28.
Am. T. & T.	142½	140½	Mex. Tel.	5	5*
Cum. Tel.	145*	145*	Mex. Tel., pfd.	6	6*
Edison E., Ill.	288	281	N. E. Tel.	137	138*
Gen. Elec.	156¼	157¾	W. T. & T.	18*	19
Mass. E. Ry.	20½	19¼	W. T. & T., pfd.	90½*	91
Mass. E. Ry., pfd.	88¼*	86			

*Last price quoted.
Shares sold for week Nov. 21 to Nov. 26.

Financial Notes.

North Shore Electric Company, Chicago, Acquires Oak Park Company.—The Oak Park Light, Heat & Power Company, of Oak Park, Ill., a suburb of Chicago, has been purchased in the interest of the North Shore Electric Company and new officers have been elected as follows: President, Frank J. Baker; vice-president, John F. Gulick; secretary and treasurer, E. D. Alexander. Mr. Baker is vice-president of the North Shore company, Mr. Gulick is secretary and treasurer and Mr. Alexander is assistant secretary and treasurer. The purchase is said to be a preliminary step toward the absorption of the Oak Park property into the system of the North Shore company, which supplies electric energy to the suburban territory around Chicago. The entire stock of the Oak Park company, of which $600,000 is outstanding, was acquired by the men representing the North Shore company. The company has a bonded debt of $600,000, and is a reorganization of the old Oak Park Yaryan Company.

Southern Power Company.—Preliminary papers have been signed at Charlotte, N. C., for the transfer to Southern Power Company interests of the holdings of the Charlotte Electric Railway, Light & Power Company. The transfer is made to the Charlotte Power Company, which is a subsidiary of the Southern Power Company. The property sold includes an extensive street railway system, totaling about twenty-five miles. The transfer was made by E. D. Latta, president of the Charlotte Electric Company. For some time the Charlotte Power Company has been seeking a franchise in Charlotte, but efforts of the interests represented by E. D. Latta proved embarrassing to the promoters, and the matter is still in statu quo. The new merger will give to the Southern Power Company control of the street railway, light and power systems in Charlotte, N. C., Anderson and Greenville, S. C., the two last named having been bought in during the past fifteen months.

Cumberland Telephone & Telegraph Company.—The monthly reports of the Cumberland Telephone & Telegraph Company are showing very satisfactory improvements over the same month last year. If the present record is kept up for the rest of the year there will be available for dividends on Dec. 31 an amount equal to about 11¾ per cent on the company's $19,680,150 dividend stock. The earnings last year were approximately 10¾ per cent. The balance available for dividends at the end of the year will probably be about $2,313,000. Since 1894 the company has steadily increased and developed its business. The capital stock in that year was $2,000,000 and the capital stock at the present time is almost $20,000,000. In 1894 the gross revenue of the company was $298,260; the estimated revenue for 1910 is $7,060.000. The territory served by the Cumberland company has increased rapidly in population and the company enjoys practically a monopoly in its field.

Denver & Intermountain Railroad Company.—A report has been filed by the Denver & Intermountain Railroad Company with the Colorado Railroad Commission, which shows that the company is controlled by the Denver Realty Company, of which William G. Evans, F. G. Moffat and J. A. Beeler are the directors. The Denver & Intermountain operates between Denver and Golden. It recently secured a revocable franchise from the City of Denver and took over the properties of the Denver, Lakewood & Golden Railroad, which were sold at a receiver's sale several years ago. This sale included the physical properties but not the company's franchise. The Denver & Intermountain is capitalized at $1,000,000 stock and $500 000 bonds, all of which are outstanding. Its officers are: W. G. Smith, president; F. L. Butler, vice-president and general manager; James H. Brown, secretary, and F. G. Moffat, treasurer.

Rockingham Power Company.—The offering for sale of the hydroelectric plant at Blewitts Falls, on the Pee Dee River, near Wadesboro, N. C., Nov. 24, failed to bring out a bidder. This is the property of the Rockingham Power Company and more than $2,000,000 has already been expended for construction work. When it was offered for sale Nov. 1 with an upset price of $1,000,000, no bid was received. The court then ordered that the upset price be reduced to $750,000 and the property again offered Nov. 24. It is now announced that no offer was received at this second attempt. The foreclosure suit was brought by the Colonial Trust Company, of Boston, trustee of the bonds.

Automatic Telephone Company.—The Automatic Telephone Company, which was recently organized at Dallas, Tex., with a capital of $500,000, has taken steps to increase its stock to $1,500,000. The company is building a 50,000-line exchange at a cost of over $200,000. It is stated that the additional capital will be used to establish exchanges in other cities and towns in that section of Texas, and to conect them with long-distance lines. There are several hundred independent telephone exchanges and systems in Texas, and connection with these is contemplated.

Chesapeake & Potomac Telephone Company.—The holders of the remaining $1,000,000 of 5 per cent first mortgage bonds of the Maryland Telephone & Telegraph Company have been notified by the Chesapeake & Potomac Telephone Company that their bonds will be redeemed on Jan. 3, 1911, at par and accrued interest. These bonds should be presented with the unpaid coupons at the National Marine Bank of Baltimore.

Commonwealth Edison Earnings.—The gross earnings of the Commonwealth Edison Company for the fiscal year which ended Sept. 30, 1910, were $13,083,000, according to the official report, which was issued last week. This is an increase of $2,440,000, or about 23 per cent, over the gross of the previous fiscal year. The net earnings for the last fiscal year were $4,641,000, an increase of $645,000, or 16 per cent, over the preceding year. In his report to the stockholders Samuel Insull, president of the company, says: "In order to take care of the company's continued increase in business your directors have acquired 112 acres of land on the north branch of the Chicago River, north of Belmont Avenue, for the purpose of building a central power plant which will have an ultimate capacity of 360,000 hp. Work on the first section of this plant is now in progress, and it is expected that 60,000 hp of machinery will be installed and in operation by next autumn." The company's connected business (exclusive of electrical energy supplied to other public-service corporations) amounted at the end of the fiscal year to the equivalent of 5,915,612 standard 16-cp lamps. The extra expenses to which the company was put on account of severe weather last winter greatly increased the operating expenses.

Mexican Light & Power Company.—Substantial increases were shown in the October earnings of the Mexican Light & Power Company and the Mexico Tramways Company as compared with the corresponding period for last year. The former company shows a gain in gross of more than $158,000, or 30.67 per cent, and an increase in net of more than 23 per cent. The Mexico Tramways Company increased its gross earnings in October something over 16 per cent, and its net earnings at about the same ratio. The excellent showing made by the Mexican Light & Power Company thus far in the current year is attributed to the fact that since the beginning of the year practically no coal has been used. In addition to this, the Pachuca Light & Power Company, which was taken over by the Mexican company last year, is contributing liberally to the increase. The Mexican Light & Power Company has very materially increased its output of energy and within a short time will be selling 25,000 hp, as compared with 6000 hp less than two years ago.

Interborough Rapid Transit Profits.—Although the Interborough Rapid Transit Company carried 400,000 more passengers during last October than in the corresponding month of 1909, and in the four months which ended Oct. 31 carried 2,495,539 more passengers than in the corresponding period of 1909, the surplus for the four months which ended with October was $275,486 less than for the same period in the previous year. This difference is explained in a report which was issued last week by Theodore P. Shonts, president of the company, who declared that the falling off in net earnings was largely due to the increased operating expenses. This increase he attributed to the expenses incident to the lengthening of the subway platforms and other physical betterments in preparation for the operation of ten-car express and six-car local trains. It is promised that these changes in the subway stations will be completed early next year. The gross earnings of the company for the four months mentioned were $8,968,020, an increase of $144,028 over the previous year.

General Motors Company.—More changes have taken place in the directory of the General Motors Company. In our issue of last week we stated that all of the old directors, excepting W. C. Durant, had retired and an entire new board of directors had been elected. Since that publication E. W. Clark, M. J. Murphy, Thomas Neal and A. H. Green, Jr., all of Detroit, have been elected directors to succeed directors temporarily chosen the week before. The new board of directors organized by electing J. J. Storrow, president; W. C. Durant, W. J. Mead, vice-presidents; C. P. Hathaway, secretary and treasurer.

Electric Traction Activity Near Chicago.—Three electric railway companies are competing for the right to build lines connecting the cities of Hammond, East Chicago, Indiana Harbor, Gary and Whiting. The Gary & Interurban Railway of Chicago has made a proposition to the City Council of East Chicago, promising to build a line running within a block of every industry and office building in the entire region. The Hammond, Whiting & East Chicago company also wants to build a loop in the district. The third company is the Northern Indiana Gas & Electric Company, financed by C. H. Geist, of Philadelphia, which is seeking a franchise in the same territory.

Interstate Railways Company.—The stockholders of the Interstate Railways Company, of Philadelphia, have adopted a resolution authorizing the conversion of $1,000,000 of unused common stock held in the treasury into 6 per cent cumulative preferred. This is to be used to settle the overdue maturing coupons on the bonds and to liquidate the floating indebtedness of the company. Of this preferred stock $615,000 has already been subscribed by the holders of the bonds and of the common stock.

Massachusetts Electric Companies.—On Sept. 30 the Massachusetts Electric Companies closed the most profitable year in its history. The gross earnings for the period were $8,560,949, and the net earnings $3,200,654. The surplus available for dividends after paying fixed charges amounts to 6.3 per cent on the $20,557,400 preferred stock. During the year the operating ratio was materially reduced and the regular 4 per cent dividend on the preferred stock was re-established.

DIVIDENDS.

Mackay Companies, quarterly, preferred, 1 per cent; common, 1¼ per cent, both payable Jan. 3.

Manhattan Railway Company, quarterly, 1¾ per cent, payable Jan. 1.

Manufactured Rubber Company, preferred, quarterly, 1½ per cent, payable Dec. 1.

Pensacola Electric Company, semi-annual, preferred, 3 per cent, payable Dec. 1.

Safety Car Heating & Lighting Company, quarterly, 2 per cent, extra 3 per cent, payable Dec. 23.

REPORTS OF EARNINGS.

	Gross Earnings.	Expenses.	Net Earnings.	Charges.	Surplus.
Butte Electric & Power Company:					
Year ended Aug. 31, 1910	$1,701,742	$676,783	$1,024,959	$376,077	$648,882
Year ended Aug. 31, 1909	1,577,663	630,892	946,771	346,986	599,783
Commonwealth Edison Company:					
Year ended Sept. 30, 1910	13,083,724	8,441,883	4,641,841	1,266,918	3,374,923
Year ended Sept. 30, 1909	10,369,446	6,642,693	3,996,752	1,182,506	2,814,246
Cumberland Telephone & Telegraph Company:					
October, 1910	612,390	349,342	272,948	48,432	224,516
October, 1909	535,324	301,115	234,209	41,801	192,408
Detroit United Railway Company:					
October, 1910	809,455	523,058	286,397	178,429	120,417
October, 1909	711,476	471,500	239,976	155,972	97,320
Interborough Rapid Transit Company:					
October, 1910	2,547,654	981,748	1,565,906	.....	.....
October, 1909	2,527,424	919,601	1,607,823	.....	.....
Kansas City Railway & Light Company:					
October, 1910	693,420	413,320	279,500	193,806	85,694
October, 1909	642,239	359,915	282,224	175,293	107,031
Mexican Light & Power Company (Mexican currency):					
October, 1910	676,120	184,720	491,400	.....	.....
October, 1909	517,271	117,796	399,475	.....	.....
Mexico Tramways Company (Mexican currency):					
October, 1910	527,603	259,835	267,768	.....	.....
October, 1909	454,637	225,095	229,542	.....	.....
Montreal Street Railway Company:					
October, 1910	386,687	205,750	180,937	31,998	148,939
October, 1909	354,007	174,735	179,272	31,079	148,193
Nashville Railway & Light Company:					
October, 1910	161,502	.....	28,036	.....	17,619
October, 1909	148,987	.....	22,300	.....	13,883
Northern Ohio Traction Company:					
October, 1910	208,342	113,371	94,971	43,367	51,604
October, 1909	184,185	100,800	84,015	44,114	39,901
Tri-City Railway & Light Company:					
Year ended Sept. 30, 1910	2,380,190	1,378,130	1,002,059	527,228	474,831
Year ended Sept. 30, 1909	1,973,756	1,115,788	857,968	113,807	344,161

General News

Construction News.

BIRMINGHAM, ALA.—The Tidewater Railway Company has been granted a franchise by the City Council over 500 blocks of city streets. A perpetual franchise for part of the proposed railway and thirty years for the remainder are granted.

DEMOPOLIS, ALA.—The contract for pumping the city water supply has been awarded to the Demopolis Electric Light & Power Company for a period of five years at a rate of $1,750 per year.

FOREMAN, ARK.—The business men of Foreman have organized a telephone company with a capital stock of $5,000. A. Goldsmith is president and John H. Hawkins is secretary and treasurer.

WALNUT RIDGE, ARK.—The business men of Walnut Ridge have raised funds for the construction of a rural telephone line eight miles northeast of this town, work on which will begin at once.

ALLEGHENY, CAL.—It is expected that the new electric lighting system will be in operation within a short time. The service will be supplied by the Middle Yuba Hydro-Electric Company.

COLUSA, CAL.—Arrangements are being made by the Pacific Gas & Electric Company for the erection of a new transmission line, carrying 15,000 volts, from Gridley to Colusa, to replace the one now in use.

LOS ANGELES, CAL.—The Board of Public Works has recommended to the Council that sixty-two lamps be installed in the Cahuenga district, recently annexed. The cost of maintaining the lamps for the remainder of the fiscal year is estimated at about $2,000.

OCEAN PARK, CAL.—The contract for the construction of the power house in Ocean Park for the Southern California Edison Company has been awarded to George D. Snyder at $3,841.

OROVILLE, CAL.—Notice of appropriation of 30,000 in. of water in the Middle Fork of the Feather River has been filed by Mrs. E. M. Lague, to be carried to a power house at the junction of Bear River and the Middle Fork. Filings amounting to 110,000 in. of water from Bear and Falls Creeks and the Middle Fork for the same power plant have been posted. A dam 275 ft. long, 80 ft. high and 40 ft. through will be built and the water carried by a ditch, twenty miles in length, to the power house.

SALINAS, CAL.—It is reported that the City Council has decided to call an election to submit the proposition to issue $125,000 in bonds for an electric light plant and water-works plant to a vote.

SAN BERNARDINO, CAL.—It is understood that the committee appointed by the Mayor to investigate the question of installing a municipal electric plant in San Bernardino will recommend establishing a municipal plant.

SAN FRANCISCO, CAL.—The Great Western Power Company has been awarded a franchise to extend its system through Albany to the north of Berkeley. The company's lines extend from Oakland through Albany to Richmond.

SAN FRANCISCO, CAL.—The Hydro-Electric Company, which has been temporarily enjoined from running a pipe line across the Mono National Forest Reserve without a permit from the Secretary of Agriculture, has notified the United States District Attorney that it would apply for a permit.

SAN FRANCISCO, CAL.—The Sacramento Valley Irrigation Company has purchased from the Westinghouse Electric & Manufacturing Company electric motors aggregating 1050 hp in three vertical units. The pumps are to be installed at the "Headgates," near Hamilton, where electrically driven pumps having a capacity of 500 hp are already in operation. The new equipment is to be used in connection with the Kuhn project, one of the largest irrigation and reclamation enterprises in California.

VENTURA, CAL.—Bids will be received by J. B. McCloskey, clerk of Board of Supervisors, until Dec. 8, for installing and maintaining electric lamps on Ventura Avenue.

BOULDER, COL.—The Boulder Electric Light & Power Company has submitted a proposition to the City Council asking for a twenty-year franchise in return for which the accompany agrees to build five miles of additional trackage within seven years and make immediate improvements to its system which will involve an expenditure of $10,000. The present franchise expires in 1913.

DENVER, COL.—It is reported that the Boston-Colorado Power Company will be reorganized under the name of the Boston-Colorado Power & Irrigation Company. The capital stock will be increased from $2,000,000 to $10,000,000 and a bond issue for $10,000,000 wil be authorized. The company claims to have secured control of eighteen natural lakes in the mountains west of Boulder and Loveland, southwest of Denver; acquired practically all the water rights of Jim Creek and Left Hand Creek and tributary streams and reservoir and power sites. It is proposed to build several power plants and irrigate a large area of land. McKnight & Henry are attorneys for the company. W. E. Renshaw, of Idaho Springs; F. D. Patterson and Richard Irvine, of New York, N. Y., are interested in the project.

FORT COLLINS, COL.—The City Council has granted the request of the business men to place large tungsten lamps on the trolley poles in the business district on College Avenue. Two lamps will be placed on each pole. It is proposed to carry out this plan on other business streets.

FORT LUPTON, COL.—The Town Council has granted the Northern Colorado Power Company a franchise to supply electrical service within the town limits. The company will also furnish many ranchers along its transmission line with electricity.

FRUITA, COL.—Carl C. Harding has applied to the Town Council for a franchise to install an electric light system in Fruita.

LAFAYETTE, COL.—The Northern Colorado Power Company is making an extension of its 44,000-volt feeder lines from the Lafayette power house, via Brighton, Fort Lupton, Evans to Greeley. The other loop via Longmont, Loveland, Fort Collins to Greeley has been in service about four years.

TRINIDAD, COL.—The question of constructing an electric interurban railway connecting Trinidad with all the coal mining camps in this section is under consideration. C. S. Weitzel, general manager of the C. F. & I. Company, is said to be interested in the project. It is understood that work will begin on construction of the proposed railway early in the spring.

WASHINGTON, D. C.—The contract for furnishing and installing an electric light plant for the temporary buildings of the workhouse, located at Occuquan, Va., has been awarded by the Commissioners of District of Columbia to the National Electrical Supply Company, of Washington, D. C., for $3,430.

LIVE OAK, FLA.—The Union Investment Company is planning to make improvements and extensions to the electric light system.

AUGUSTA, GA.—The City Council has appointed a committee to investigate the question of improving the street lighting system and the establishment of a "Great White Way." The construction of a municipal electric light plant has been suggested, but no definite movement has been made. The Augusta Railway & Light Company has the contract for street lighting.

MACON, GA.—The H. E. Lowe Electric Company, of Macon Ga., has secured the contract for the electrical equipment for the new building to be erected for the Macon *Telegraph*. The contract includes motors for the operation of presses and linotype machines.

STONE MOUNTAIN, GA.—The citizens of Stone Mountain are endeavoring to persuade the Georgia Railway & Electric Company to extend its railway from Decatur, located six miles from Atlanta, to Stone Mountain, a distance of ten miles, making the total length of the proposed branch sixteen miles in length.

POCATELLO, IDAHO.—The Commercial Club is considering the question of installing an ornamental electric lighting system on the principal streets in Pocatello. It is proposed to erect cluster lamps.

CHICAGO, ILL.—The North Shore Electric Company has purchased the plant and holdings of the Oak Park Light, Heat & Power Company. The Oak Park Company is capitalized at $600,000, and has a bonded indebtedness of $600,000.

CHICAGO, ILL.—Sealed bids will be received at the office of the business manager of the Board of Education, 730 Tribune Building, Dearborn and Madison Streets, Chicago, Ill., until Dec. 7, for construction of addition to the Howe School, including telephones, bells, electric work, steam heating, ventilation, etc., in accordance with plans and specifications prepared by A. F. Hussander, acting architect, and N. L. Patterson, acting chief engineer, which may be seen at the office of the architect, Room 714, Tribune Building, Dearborn and Madison Streets, Chicago, Ill.

IPAVA, ILL.—F. R. Dennis, of Peoria, Ill., owner of the local electric light plant, has submitted a proposition to the Village Board offering to sell his plant to the town. The installation of an entire new plant is advocated.

MARSEILLES, ILL.—The Northern Illinois Light & Traction Company is reported to have awarded the contract for the construction of a hydroelectric power plant at Marseilles to the L. E. Myers Company, Railway Exchange Building, Chicago, Ill., to cost about $300,000. The proposed power plant will supply electricity for operating the railway system of the Northern Illinois Light & Traction Company in northern Illinois.

SAYBROOK, ILL.—The electric plant of the Saybrook Electric Light, Heat & Power Company was destroyed by fire on Nov. 17, causing a loss of $5,000. R. N. Cooper is president and manager.

COLFAX, IND.—Steps have been taken by the Town Council for the installation of a municipal electric light plant in Colfax.

CRAWFORDSVILLE, IND.—Work has been commenced by a board of appraisers for placing a valuation on the old municipal electric light plant, which the City Council will soon advertise for sale. It is ex-

pected that the new municipal electric plant will be completed in a short time.

HUNTINGTON, IND.—Arrangements are being made by Orton & Steinbrenner, of Chicago, Ill., for the construction of a factory building at Huntington, 80 ft. x 160 ft., which will be equipped for electric motor drive. The company will manufacture locomotive cranes.

INDIANAPOLIS, IND.—C. J. Wheeler, custodian of the State House and grounds, has entered into a contract with the Merchants' Light & Heat Company for furnishing electricity for lighting the buildings and grounds at the rate of 3½ cents per kw-hour, not including globes. Under the new contract the price has been reduced from 10 cents to 3½ cents per kw-hour, which will reduce the cost about $7,000 per year.

LAFAYETTE, IND.—Preparations are being made by the Lafayette Telephone Company for the erection of a number of new cable leads and the installation of several toll lines.

PERU, IND.—Arrangements are being made by the Home Telephone Company for the construction of a new telephone exchange in Peru at a cost of $10,000. Automatic switchboards will be installed.

BONAPARTE, IA.—S. E. Irish, of Keosauqua, Ia., who recently purchased the Meek dam, is reported to be contemplating organizing a company to rebuild the dam and install an electric plant to develop about 1200 hp.

CHARLES CITY, IA.—Plans are being considered by the City Improvement Association for the installation of forty-two electroliers at a cost of $75.50 each.

DOWS, IA.—The proposition to grant a franchise to the Dows Electric Company will be submitted to a vote on Dec. 6.

FOREST CITY, IA.—The plant and holdings of the Forest City Electric Light & Power Company have been purchased by Frank Kellogg of Seymour, Ia. M. E. Barton, president and manager of the Forest City Company, will have charge of the plant.

WAPPELLO, IA.—It is reported that a project is on foot to utilize the water power of the old millrace to operate a hydroelectric plant. The cost of the proposed plant is estimated at about $300,000. Utt Brothers, of Chicago, Ill., are said to be interested in the project.

WATERLOO, IA.—An ordinance to fix the standard of street lamp posts in Waterloo is under consideration by the City Council. The proposed standards are to be 13 ft. 6 in. high, with top globe 16 inches in diameter, and four side lamps, all to be equipped with 100-watt tungsten lamps. The poles are to cost $55 each, to be paid for by the property owners, and the maintenance to be borne by the city.

WEBSTER CITY, IA.—The Fort Dodge, Des Moines & Southern Railroad Company is reported to have purchased the Crooked Creek Railway, seventeen miles in length, and proposes to equip it for electrical operation, work on which will begin at once.

LOUISVILLE, KY.—Sealed proposals will be received at the office of the Board of Public Works, Louisville, Ky., until December 9, for the installation of a new magnetic controlled electric passenger elevator in the city hall. Plans and specifications can be seen at the office of the Board of Public Works. Cost of work is estimated at $6,000. Roger G. McGrath is secretary of board.

NEW ORLEANS, LA.—A new company has been formed by the business men of New Orleans for the purpose of purchasing the plant and holdings of the Consumers' Electric Company, which was recently placed in the hands of a receiver. The new company will be known as the Consumers' Electric Light & Power Company, and will be capitalized at $1,500,000. The court has ordered the plant to be sold on Dec. 17. The property is valued at $1,200,000. Samuel Insull, of Chicago, Ill., is receiver. The directors of the new company are: Charles E. Fenner, Walker B. Spencer, Bernard J. Mayer, Esmond Phelps and M. S. Hart.

ORONO, MAINE.—Preparations are being made by the Penobscot Realty Company, which has purchased the power site and most of the holdings of the James Walker Company, in Orono, for the construction of a large hydroelectric power plant. The proposed power plant will develop from 3000 to 5000 hp, and will cost about $300,000.

BALTIMORE, MD.—Proposals will be received by the Board of Awards at the office of J. Sewell Thomas, City Register, city hall, Baltimore, Md., until Dec. 7, for installing electric wiring at the sewage-pumping station, as per plans and specifications on file at the office of Calvin W. Hendrick, chief engineer of the sewerage commission. Plans and specifications can be obtained on application at the office of the sewerage commission, Room 904, American Building, Baltimore, Md. J. Barry Mahool is president, Board of Awards.

HAGERSTOWN, MD.—It is reported that Pierre O. Keilholtz, consulting engineer, Continental Building, Baltimore, Md., is preparing plans for a new power house for the Union Power Company, bids for construction of which will soon be called.

CHICOPEE, MASS.—The Electric Light Commissioners are considering the question of extending the municipal electric light system to Fairview. It is proposed to purchase the equipment owned and operated by the South Hadley Falls Electric Light Company in Fairview, which has supplied electrical service in that village since 1895. The street lighting system includes about forty lamps.

HOLYOKE, MASS.—Plans are being considered to erect twenty-two tungsten lamps between Race and Main Streets on Dwight Street. The lamps will be furnished and maintained by the owners and tenants of the block.

MUSKEGON, MICH.—The injunction obtained by the Muskegon Traction & Lighting Company restraining the city from selling bonds for the municipal electric light plant has been dissolved. It is said that steps will be taken to construct a municipal plant at once.

BALATON, MINN.—The Village Council is reported to be considering the question of installing a street lighting system.

DULUTH, MINN.—Preliminary plans are being prepared by the Great Northern Power Company for the erection of an electric transmission line from Thomson direct to Superior, with a distributing station in Duluth, which will involve an expenditure of about $200,000. W. N. Ryerson is general manager.

FERGUS FALLS, MINN.—Owing to the low water in the river the Otter Tail Company is installing an auxiliary steam plant at a cost of about $25,000. The company has announced that it will be obliged to increase its rates for electricity, owing to the increase in cost of operating the steam plant. The company supplies electricity for operating the municipal electric plant, and it is expected that the city will be obliged to increase its rates to consumers temporarily. At the present time the company is able to supply only a ten-hour service, owing to the lack of water.

LOWRY, MINN.—The question of installing an electric light plant in Lowry is reported to be under consideration. Misenol & Leslie, it is stated, are interested in the project.

MINNEOTA, MINN.—The Village Council has granted a franchise for the installation of an electric light plant in Minneota.

ROCHESTER, MINN.—The Public Utility Board is reported to be contemplating extending the electric lighting system in the Kutzky's addition.

ST. CLOUD, MINN.—Sealed bids will be received by the State Board of Control, State Capitol Building, St. Paul, Minn., until Dec. 5 for the completion of part of the interior of the administration building of the Minnesota State Reformatory, St. Cloud, Minn., including the general contract work, plumbing, heating and electrical work; also a separate bid for plumbing, heating and electrical work for a new hospital building at the reformatory in accordance with plans and specifications furnished by Clarence H. Johnston, architect, 715 Capital Bank Building, St. Paul, Minn., and Charles L. Pillsbury Company, engineer, 805 Metropolitan Life Building, Minneapolis, Minn. Plans and specifications can be seen at the Builders' Exchange, St. Paul, Minn.; Builders' Exchange, Minneapolis, Minn.; office of the State Board of Control, and at the office of the superintendent of the State Reformatory.

VIRGINIA, MINN.—Sealed proposals will be received at the office of O. Halden, county auditor, Court House, Duluth, Minn., and also at the office of Bray & Nystrom, architects, Palladio Building, Duluth, Minn., until Dec. 6 for furnishing and installing electric fixtures in the Range District Court Building at Virginia, Minn.; also alternate bids, substituting black iron standards instead of the two solid bronze standards in front of the building, plans and specifications for which can be secured from the architects.

WINONA, MINN.—The City Council has granted the Tri-State Telephone Company permission to enter the city with its lines.

HATTIESBURG, MISS.—Application has been made to the Council by W. S. F. Tatum and W. O. Tatum for a franchise to construct and operate an electric light plant in Hattiesburg, Miss.

JEFFERSON CITY, MO.—Sealed bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C. until Dec. 22 for the installation of a conduit and wiring system and gas piping at the United States post office and court house building in Jefferson City, Mo., in accordance with plans and specifications, which can be secured at the above office or of the custodian at Jefferson City, Mo. James Knox Taylor is Supervising Architect.

ST. LOUIS, MO.—The Union Electric Light & Power Company has recently opened a new electric automobile garage at Twentieth and Locust Streets for the benefit of electric vehicles in the city.

CULBERTSON, MONT.—Application has been made to the Council by W. E. Pierce for a franchise to install an electric light plant.

ANSLEY, NEB.—Bonds to the amount of $5,000, the proceeds to be used for the installation of a municipal electric light plant, have been voted.

BEATRICE, NEB.—The contract for furnishing material and making improvements to water works has been awarded to the Matthews Construction Company, of Kansas City, Mo., for $57,000. The W. K. Palmer Company, Dwight Building, Kansas City, Mo., has charge of the engineering work.

OMAHA, NEB.—Sealed bids will be received by the Board of County Commissioners of the County Douglas, addressed to D. M. Haverly, County Clerk, Omaha, Neb., until Dec. 17, for furnishing and installing three direct-connected engines and generators, including foundations, immediate steam supply and exhaust connections, wiring from generators to switchboard and three generator panels in the Douglas County courthouse, in accordance with specifications on file in the office of the County Clerk and John Latenser, architect, 632 Bee Building, Omaha, Neb. Copies of specifications can be obtained upon application to the architect. Bids will also be received at the same time and place for the installation of a vacuum cleaning system for the Douglas County courthouse. D. M. Haverly is County Clerk.

PETERSBURG, NEB.—Bids will be received by J. W. Jungels, rector, Petersburg, until Jan. 3, for the installation of heating, lighting

and plumbing systems in the school house of the St. John the Baptist Church of Petersburg. Plans and specifications are on file at the office of James C. Stitt, architect, Norfolk, Neb.

SILVER CREEK, NEB.—Application has been made to the Council by the Montoe Telephone Company for a franchise to extend its telephone lines into Silver Creek.

GARFIELD, N. J.—At a special election held recently the citizens voted to issue $25,000 in bonds, the proceeds to be used for the installation of a municipal electric light plant.

JERSEY CITY, N. J.—Contracts for the construction of the new power house of L. O. Koven & Brothers, located on the Paterson Plank Road, has been awarded to William Whyte and Robert Cook. The building will be 50 ft. x 75 ft., one story high, and will cost about $25,000.

RED RIVER, N. M.—The application of the Red River Land & Water Company for 629 second ft. of water of the Red River, to be used for the reclamation of 45,000 acres of land in Taos County has been approved by Vernon L. Sullivan, Territorial Engineer.

ALBANY, N. Y.—The Board of Contract and Supply will soon call for bids for lighting the streets of the city for a term of five years. The present contract expires June 21, 1911.

ALBANY, N. Y.—Sealed proposals will be received by F. C. Stevens, Supernitendent of Public Works, Capitol Building, Albany, until Dec. 21 for the construction and equipment of a hydroelectric power plant on the Erie Canal, near the east end of Crescent Dam, on contract No. 91, Erie Canal, section 1.

ALBANY, N. Y.—The Trustees of Public Buildings have approved plans and specifications submitted by Franklin B. Ware, State Architect, for the construction of the new power house and conduits for the Capitol and the State Education Building. The power house will be located on North Hawk Street, between Sheridan Avenue and Orange Street. The plans provide for a boiler room with sufficient space for the installation of ten boilers of 380 hp each, and an engine room of sufficient size to install five engines and generators with a rating of 1700 kw. At present only eight boilers will be installed. The cost of the building is estimated at $500,000. It is expected that bids for heating, lighting and mechanical equipment will be called for soon.

BUFFALO, N. Y.—The contract for the three steam turbines, having a rating of 5000 kw each, with jet condensers, for the new pumping and electric station at the foot of Porter Avenue has been awarded to the Westinghouse Machine Company, of Pittsburgh, Pa., for $248,180.

FREEPORT, N. Y.—The question of increasing the output of the municipal electric light plant is reported to be under consideration. It is proposed to install a new arc lamp system and furnish electricity for motors.

GLENS FALLS, N. Y.—The Hudson River Electric Company has applied to the Public Service Commission, Second District, for permission to enter into a contract with the village of South Glens Falls to supply electricity for public lighting.

JOHNSTOWN, N. Y.—The Common Council has taken steps toward the construction of a municipal electric light plant in Johnstown, providing it is deemed necessary at the expiration of the present street lighting contract in 1913.

NEW YORK, N. Y.—Bids will be received at the office of the Commissioner of Immigration, Ellis Island, N. Y., until Dec. 5, for furnishing material and installing electric tie lines between the power houses on No. 1 and 3 Islands, at the United States Immigrant Station, Ellis Island, New York Harbor.

NEW YORK, N. Y.—Bids will be received by the Department of Public Charities, foot of East Twenty-sixth Street, New York, N. Y., until Dec. 27 for furnishing and installing electric work, elevator work, interior finishings, fixtures, vacuum-cleaning plant and other work for the completion of a nurses' home building for the Children's Hospital, located at the north end of Randall's Island, Borough of Manhattan. Blank forms and further information may be obtained at the office of Raymond F. Almirall, architect, 185 Madison Avenue, New York, N. Y., where plans and specifications may be seen. Michael J. Drummond is commissioner.

PHELPS, N. Y.—The Geneva-Seneca Electric Company, of Geneva, N. Y., has applied to the Public Service Commission, Second District, for permission to purchase the plant and holdings of the J. Q. Howe Sons' Electric Company, of Phelps. It is understood that the sale price is to be $18,000. If the sale is ratified, it is reported that the Geneva-Seneca Electric Company will erect a transmission line from Geneva to Newark, via Phelps, and establish a twenty-four-hour service in this town.

SYRACUSE, N. Y.—The North Side Citizens' Association has appointed a committee to secure estimates of the cost of installing an ornamental street lighting system for the North Side and to make arrangements with the mechants in that district to install and maintain the same. Jacob Armbruster, F. X. Gefliger and Joseph Rees are members of the committee.

BLACK MOUNTAIN, N. C.—Preparations are being made by the Blue Ridge Association for municipal improvements, including the construction of a dam and electric light plant, water-works and sewerage system, etc. F. C. Abbott is secretary and treasurer.

CHARLOTTE, N. C.—The Southern Power Company is reported to have purchased the entire interests of the Charlotte Electric Street Railway Company, which is capitalized at $1,125,000, and the Charlotte Gas & Electric Company, capitalized at $225,000, thereby securing the street car system, comprising twenty-five miles of trackage and all equipment, and the gas, electric light and power systems of the city. It is understood that the price paid for the properties was not far from $2,000,000.

DILLSBORO, N. C.—An electric plant is being installed at the Harris Roller Mills in Dillsboro. The plant will supply electricity for Dillsboro, Sylva and the tannery.

BUXTON, N. D.—At the annual meeting of the stockholders of the Red River Valley Telephone Company, it is said, the proposition to increase the capital stock of the company to $200,000 will be taken under consideration, the proceeds to be used for extensions to its system.

COSHOCTON, OHIO.—The Coshocton Light & Heat Company is reported to have entered into a contract with James B. Clow & Sons to supply electricity to operate its mills, located just south of the city. The company will furnish 500 hp at first, which will be increased to 800 hp within a few months.

DEFIANCE, OHIO.—The Defiance Interurban Electric Railway Company, recently incorporated with a capital stock of $50,000, is planning to construct an electric railway from Defiance, Ohio, to Fort Wayne, Ind. It is understood that most of the right-of-way has been secured.

JACKSON, OHIO.—Bids will be received by W. A. Dallas, clerk of board of public affairs, until Dec. 19 for machinery in connection with improvements to the municipal electric light plant, the cost of which is estimated at $11,000. Bids were received Oct. 20 for the above work, but were rejected.

LIMA, OHIO.—Arrangements are being made by the Lima Telephone & Telegraph Company for extensive improvements to its system soon after the first of the year. The work will include the erection of a new exchange building and the installation of a new switchboard, and involve an expenditure of more than $100,000.

MOUNT VERNON, OHIO.—The Mount Vernon Electric Company has filed amendments to its charter with the Secretary of State increasing its capital stock from $10,000 to $300,000.

WARRENSVILLE, OHIO.—The contract for installing a steam and electric generating unit, switchboard and appliances for the Service Quadrangle, Colony Farm, Warrensville, has been awarded to the Brownell Company, of Dayton, Ohio, for $3,200. C. A. Marvin is secretary.

NELAGONEY, OKLA.—The Osage Manufacturing Company, of Joplin, Mo., is planning to erect a clay working and ice plant in Nelagony, for which machinery has been purchased. It is said that the company proposes later to install an electric light and power plant and water-works system. J. S. Roberts, of Joplin, Mo., is president.

OKLAHOMA CITY, OKLA.—Bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until Dec. 28 for the installation of conduit and wiring system and gas piping in the United States post office building at Oklahoma City, Okla., according to plans and specifications, copies of which may be obtained at the above office or at the office of the superintendent of construction, Oklahoma, Okla. James Knox Taylor is Supervising Architect.

HARRISBURG, ORE.—The Council has contracted with the Northwestern Corporation to furnish electricity for street lighting.

JUNCTION CITY, ORE.—The Council has entered into a contract with the Northwestern Corporation, of Eugene, for lighting the streets of the city. About seven arc lamps and forty incandescent lamps will be placed on the streets.

PORTLAND, ORE.—Announcement has been made that the United Railways Company and the Oregon Electric Railway Company will make extensive extensions to their systems in and around Portland during the coming year which will involve an expenditure of from $7,000,000 to $10,000,000. Work will begin at once on Tenth and Salmon Streets extension of the Oregon Electric Railway Company. John F. Stevens is president of both companies.

UNION, ORE.—Plans are being made for the construction of a municipal electric light plant, for which bonds to the amount of $71,000 have been authorized. L. C. Kelsey, of Salt Lake City, Utah, is consulting engineer.

VALE, ORE.—The plant and holdings of the Vale Light & Power Company have been purchased by the Telluride Power & Investment Company, of Salt Lake City. F. A. Boyd, of Provo, Utah, will have charge of the local plant.

CLARION, PA.—The Clarion & East Brady Electric Railway Company, of Clarion, Pa., is asking for bids for construction of power house and equpment for same, including three 500-kw turbo-generator sets, condensing, steam pressure, 200 lb., either vertical or horizontal; water-tube boilers; three surface condensers; vacuum pump; open feed-water heater; two boiler feed pumps, either duplex or multi-stage driven, driven by steam turbine; three 20-kw exciter sets; six motor-generator sets; three circulating pumps; hot well pump; transformers and substation equipment. Specifications will be furnished on application. Contract has been awarded for construction of the first six miles to Ridge Brothers, of Pittsburgh, Pa. The proposed railway will be thirty miles in length. For further information address T. S. Arnold.

CLYMER, PA.—The Clymer Light, Heat & Power Company is making rapid progress with construction of its new power plant at the Bar Slope, one of the Clearfield bituminous coal mines, near Dixonville. The plant when completed will supply electricity in Clymer, Dixonville, Marion Center, Lovejoy and other towns in this vicinity. The Borough of Clymer

has entered into a contract with the company for street lamps. It is expected to have the system in operation early in December.

LARIMER, PA.—The stockholders of the Larimer Telephone Company have voted to increase its capital stock for the purpose of extending its lines through Wittenberg, Greenville and Southampton. It is expected to have the lines completed this fall.

NEW KINGSTON, PA.—The Kingston Rural Bell Telephone Company, recenty organized, is planning to erect and operate a telephone line, five miles in length, from New Kingston to Mechanicsburg, to connect with the Bell system at the latter place. Charles Herrick, of New Kingston, Pa., is agent.

RENOVO, PA.—The Renevo Edison Light, Heat & Power Company is extending its transmission lines to Farwell to supply electricity in that town.

GREENVILLE, S. C.—The erection of a large plant for the manufacture of fine yarns in Greenville is being promoted, machinery for which has been purchased. The plant will be operated by electricity, for which 1500 hp will be required. Contracts for construction of buildings will be awarded as soon as plans are completed. The equipment will include 50,000 spindles and 1200 looms. J. 1. Westervelt will be manager.

ROCK HILL, S. C.—Owing to the refusal of the Rock Hill Water & Electric Company to accept an offer of $100,000 for its holdings in this city, the City Council has authorized the Board of Public Works to proceed with the construction of a municipal electric light and water plant. A site has already been purchased. A. P. Maloney, of Philadelphia, Pa., is president of the company.

BROOKINGS, S. D.—Sealed proposals will be received by the Board of County Commissioners of Brookings County until Dec. 28 for construction of court house building, including heating, electric work and plumbing, in the City of Brookings. Plans and specifications are on file at the office of C. E. Bell, Tyrie & Chapman, architects, Auditorium Building, Minneapolis, Minn., and at the office of O. J. Otternes, county auditor, Brookings.

EGAN, S. D.—The proposition to issue bonds for the installation of an electric light plant in Egan will be submitted to a vote.

EUREKA, S. D.—The Council has granted a franchise to G. A. McLaughlin, of Aberdeen, S. D., for the installation of an electric light system in Eureka. It is expected to have the plant in operation by March 1, 1911.

LETCHER, S. D.—The installation of an electric light plant in Letcher this winter is reported to be under consideration by the town officials.

OLDHAM, S. D.—The contract for installing a low-voltage storage battery light plant having sufficient capacity to provide for 1500 lamps has been awarded to the Battery Power Company, of Milwaukee, Wis.

DUCKTOWN, TENN.—It is reported that the Westinghouse Electric & Manufacturing Company has received the contract for the installation of electrical equipment for the power plant now being built on the Ocoee River, near Ducktown. The cost of the machinery is estimated at about $250,000.

ABILENE, TEX.—The City Council has adopted an ordinance requiring that telegraph, telephone and electric wires be placed in underground conduits on certain streets of the city.

AUSTIN, TEX.—W. C. Day, superintendent of public buildings and grounds, has filed his report with the Governor, in which he asks that appropriations be made for new machinery for the power house which supplies electricity for heating and lighting the Capitol Building and grounds. The cost is estimated at about $10,000.

BEEVILLE, TEX.—A deal has been closed whereby the Beeville Ice & Light Company will take over the plant of the Beeville Ice Company. The new owners propose to install an electric light and power plant to be operated in conjunction with the ice plant.

GRAPELAND, TEX.—G. W. Johnson & Company, of Kansas City, Mo., are reported to have submitted a proposition to the Council to install an electric light plant in Grapeland.

SAN ANTONIO, TEX.—The Board of County Commissioners of Bexar County has granted J. A. Logwood a franchise to build an electric railway from the terminus of the San Antonio Traction Company's track at Harlandale, south on the Corpus Christi Road, through a suburban district.

TEXAS CITY, TEX.—It is reported that Fordyce Ridley, of Galveston, Tex., and associates will construct a street railway in Texas City. The proposed railway will be about three miles in length and gasoline motors will be used.

VICTORIA, TEX.—The Victoria Manufacturing Company has recently installed a new electric light plant. The street lighting system consists of 150 tungsten lamps of 60 cp and seven 1200-cp arc lamps.

RUTLAND, VT.—The Rutland Railway, Light & Power Company has petitioned the State Legislature for amendments to its charter which will grant to it the privilege to build an electric railroad through Wells, Middleton, Manchester and Dorset; also for the right to distribute and sell electricity in these towns. If permission is granted the company will begin work on construction of the railway in the spring, which will eventually be extended to Granville, N. Y. The company is now building a railway from Fair Haven to Poultney, which is nearly completed.

FORT MONROE, VA.—Bids will be received at the office of the quartermaster, Fort Monroe, Va., until Dec. 10 for furnishing 520 electric fixtures, 300 ft. of cable, 200 lb. assorted nails, 40 lb. assorted tape and 3000 ft. rubber-covered wire. Captain Curtis C. Rorebeck is quartermaster.

BERLIN, WASH.—It is reported that arrangements are being made to increase the output of the Apex Gold Mine in Berlin. It is proposed to install a 6-drill air compressor, enlarge the electric power plant on Money Creek and reconstruct its railroad.

CHELAN, WASH.—The Chelan Land Company is contemplating the erection of a telephone line to connect its land holdings with Chelan.

CLARKSTON, WASH.—Contracts have been awarded by the Lewiston-Clarkston Improvement Company for the construction of a concrete power house and equipment, aggregating more than $100,000. The equipment will be supplied by the General Electric Company, of Schenectady, N. Y., and Charles C. Moore & Company will erect the building. The new plant will be erected adjoining the present steam plant and will have an output of 2000 hp.

NORTH YAKIMA, WASH.—Preparations are being made by the Pacific Power & Light Company for extending its transmission lines through Selah and Wenas valleys. It is proposed to eventually extend the lines through the Ahtanum, Cowiche and other valleys. George C. Arrowsmith is general manager.

SEATTLE, WASH.—It is reported that the Seattle-Everett Traction Company will soon apply to the County Commissioners for a franchise to construct an electric railway to Lake Burien, seven miles south of Seattle.

SEATTLE, WASH.—At an election held recently five bond propositions were approved by the voters, aggregating $2,678,000, of which the proceeds of $1,400,000 will be used for the extension of the municipal electric light plant, including the construction of a dam on Cedar River.

SPOKANE, WASH.—It is said that the Council fire, water and sewer committee will recommend that the municipal electric power plant be located on the Pend Oreille River, near Metaline, where it is estimated that from 5500 to 6000 hp could be developed and delivered in Spokane by a 100-mile transmission line. The cost of the plant complete is estimated at $5,000,000.

STANWOOD, WASH.—L. F. Query has been granted a franchise by the Snohomish County Commissioners to erect and operate an electric light system in Stanwood.

TACOMA, WASH.—Announcement has been made that the Pacific Telephone & Telegraph Company is planning to erect two new telephone exchanges in Tacoma, one in the north end of the city and the other in the south. The improvements contemplated will involve an expenditure of about $300,000.

CARBONDALE, W. VA.—The Sunday Creek Company is reported to have placed a contract with the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa., for one 200-kw., 250-volt, direct-current, engine type generator.

ENDEAVOR, WIS.—The Endeavor Electric Light & Power Company, it is reported, is planning to install an electric generating plant in the spring. William H. Burwell is manager.

MILWAUKEE, WIS.—At an election held recently the citizens voted to appropriate $550,000 for the installation of a municipal electric light plant to supply electricity to light the streets, parks and public buildings. It is proposed to utilize the waste steam of the city garbage destructor plant on the lake, where tests made some time ago showed that sufficient steam is available to operate the proposed plant. There are now 3000 street arc lamps needed for the city, but the proposed plant would only be able to provide electricity for about 1000 arc lamps.

NEILSVILLE, WIS.—Arrangements are being made by the Wisconsin Furnituring Company for the construction of a new plant to replace the factory of the Reliable Furniture Manufacturing Company, burned some time ago. The proposed plant will be equipped for electric motor drive. It has not been decided whether to install a steam-driven plant or to purchase energy.

VALDERS, WIS.—The Oslo Lighting & Power Company is reported to be planning to install a power plant in Valders, and will soon be in the market for equipment for a steam generating plant, including boilers.

WAUSAU, WIS.—The installation of a municipal electric light plant in Wausau is under consideration.

CHEYENNE, WYO.—The Police and Fire Board has recommended two ordinances to the City Council governing electric wiring and gasoline lighting installation. Both resolutions are supported by the Underwriters and the Northern Colorado Power Company.

LOVELL, WYO.—At an election held recently the citizens voted to appropriate $7,000 for the installation of an electric light system and $5,000 for the extension of the water-works system.

COQUITLAM, B. C., CAN.—The ratepayers have voted in favor of the bylaw granting the Western Canada Power Company a franchise to erect its transmission lines through Coquitlam and supply electricity in this city for lamps, heat and motors.

PRINCE RUPERT, B. C., CAN.—Bids will be received by Alexander Johnston, Deputy Minister of Marine and Fisheries, Department of Marine and Fisheries, Ottawa, Ont., Can., until Jan. 3, 1911, for construction of a buoy depot at Prince Rupert, B. C., including the erection of a reinforced-concrete wharf, timber approach trestle, power house, with chimney buoy shed, stores, offices and dwellings; also installation of

drainage and water systems. Plans and specifications and forms of tenders can be procured at the above office and at the office of the agent of the Department of Marine and Fisheries, Victoria, B. C.; Halifax, N. S.; St. John, N. B.; Quebec and Montreal; at the post office, Prince Rupert, B. C., and at the custom house, Winnipeg, Man., Can. Only bids for the entire work will be considered.

VANCOUVER, B. C., CAN.—Inducements are being offered to the British Columbia Electric Railway Company by the property owners along Nanaimo Street to construct an electric railway along that street. It is said that a bonus of $55,000 may be offered the company.

VERNON, B. C., CAN.—Bids will be received until Dec. 19 by the Public Works Department, Ottawa, Ont., for electric light fixtures, wiring, etc., for public buildings at Vernon. R. C. Descrochers is secretary.

BERLIN, ONT., CAN—The light committee has fixed the rates for service for residential lighting from the Hydro-Electric Power Commission. There will be a fixed rate of 5 cents per month for each 100 sq. ft. area lighted, and a charge of 4 cents per kw-hour for electricity used. A discount of 10 per cent is allowed if paid within a month and a further discount if paid within ten days. A flat rate of $6 per month for all purposes has been decided upon. The rates for power service have not yet been decided upon.

BRANTFORD, ONT., CAN.—The Grand Valley Railway Company is contemplating the erection of a 40,000-volt transmission line through Paris from Brantford to Galt. The company now purchases electricity from the Cataract Power Company to operate its railway between Brantford and Paris, and proposes to extend the service from Paris to Galt. It is proposed to discard the steam-driven power plant which supplies energy for operating the railway between Paris and Galt. It is also proposed to furnish electrical service to towns and villages along the route of the railway. W. P. Kellett is general manager and electrical engineer.

MITCHELL, ONT., CAN.—The citizens have voted in favor of the by-law to issue $9,000 in debentures, the proceeds to be used to install equipment in the municipal electric plant to utilize electricity supplied by the Hydro-Electric Power Commission. It is expected to have the new system ready for operation by February.

NORTH TORONTO, ONT., CAN.—A by-law to authorize the Town Council to install an electric plant at a cost of $18,000 to furnish electricity for lighting the streets and residences of the town will be submitted to a vote on Jan. 1.

MONTREAL, QUE., CAN.—The City Council at a meeting held Nov. 14 adopted a resolution to prepare by-laws providing for the borrowing of $10,000,000 for public improvements, of which $1,000,000 will be used for a municipal electric plant, and $1,000,000 for underground conduits. The Council has awarded the contract for a motor-driven centrifugal pump to the John McDougall Caledonian Iron Works Company, of Montreal, Que., for $7,716.

SHERBROOKE, QUE., CAN.—Preparations are being made by Messrs. Ross & Holgate, of Montreal, Que., for the construction of a power plant on the Magog River, bids for which will be received until Dec. 29. The cost of the work is estimated at about $60,000.

DURANGO, MEX.—The Compania de Madera de la Sierra, which operates lumber mills near Llano Grande, in this state, is planning to install a hydroelectric power plant in the San Vicente district, to furnish electricity to operate its mills and other industrial plants in this section.

GUANACEVI, DURANGO, MEX.—E. Schondube, of Mexico City, Mex., has been granted a concession by the government of the State of Durango for the installation of a large hydroelectric plant and the erection of transmission lines in this section of Mexico. The proposed plant will be located near Guanacevi. Electricity will be transmitted to the mines in this section and the districts of El Oro, Tepehuanes and Inde. Under the terms of the concession Mr. Schondube is to supply electricity to the state government for lamps and motors for a period of five years free of charge, and after that time at 50 per cent less than to other consumers.

MEXICO CITY, MEX.—The National Congress has passed a bill authorizing the Mexican Tramways Company to construct two new electric railways. One of the proposed roads is to extend from Mexico City to Puebla, a distance of about 125 miles, and the other to Toluca, forty-five miles long, for which preliminary surveys have been made. The proposed railway will give both passenger and freight service.

New Industrial Companies.

THE AMERICAN ADVERTOGRAPH COMPANY, of Newark, N. J., has been incorporated by J. Weener, S. W. Gordon and J. Einwachter, of Newark, N. J. The company is capitalized at $150,000 and proposes to manufacture automatic advertising devices, weighing machines, etc.

THE AMERICAN & FOREIGN OPERATING COMPANY has filed articles of incorporation with a capital stock of $1,500,000. The incorporators are: J. G. Gray, S. S. Adams, Jr., and M. B. F. Hawkins, of Wilmington, Del.

THE CASE PATENT METAL BOILER CLEANER COMPANY, of New York, N. Y., has been incorporated with a capital stock of $300,000 by W. McLaughlin, of Philadelphia, Pa.; M. H. Haskin and G. Krengel, of New York, N. Y. The company proposes to manufacture compounds for cleaning boilers, etc.

THE ELECTRIC APPRAISAL & INSPECTION COMPANY, of Cleveland, Ohio, has been incorporated with a capital stock of $10,000 by W. H. Hasselman, T. T. Quick, E. M. Fisher and J. J. Shipley.

THE ELECTRIC HEAT STORAGE COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $1,500,000 by T. F. Murtha, P. B. Hanson and P. H. Zornow, of New York, N. Y. The company proposes to manufacture and deal in electric heating and heat storage apparatus.

THE GLYDE CONSTRUCTION COMPANY of Detroit, Mich., has been chartered with a capital stock of $52,000 by Henry R. Adams, of Grand Rapids, Mich.; Frank W. Wheeler and George H. Sweet, of Detroit, Mich. The company proposes to construct water power plants, steam power plants, and build and equip railroad, telephone and telegraph lines.

THE H. MUSSO COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $10,000 for the purpose of manufacturing telephone and telegraph instruments. The incorporators are: Charles V. Paterno, Northern Avenue and 182d Street; Giuseppe Musso, 440 Riverside Drive; John M. Stoddard, 135 Broadway, all of New York, N. Y.

THE IMPERIAL ENGINEERING COMPANY, LTD., of Montreal, Que., Can., has been incorporated with a capital stock of $100,000 and proposes to do a general engineering and contracting business, including street railway work, hydroelectric work, etc. Lawford Grant, of Montreal, Que., is reported to be interested in the project.

THE ISLAND PARK COMPANY, of Plainfield, N. J., has been incorporated by H. O. Coughlan, L. H. Guenther and John R. Turner. The company is capitalized at $50,000 and proposes to engage in a general electrical business and also deal in lumber and real estate.

THE KING PHONE DISTRIBUTING COMPANY, of Pittsburgh, Pa., has been incorporated with a capital stock of $2,000 by Raymond M. Kaufman, Karl J. Kaufman and Chester Kaufman, all of Pittsburgh, Pa. The company proposes to deal in telephones.

THE MILLAR ELECTRIC COMPANY, of Springfield, Ill., has been chartered by John J. Offield, Charles J. Schmidt and Frank R. Belknap. The company is capitalized at $10,000 and proposes to manufacture and deal in electrical devices and machinery.

THE MOTORS ENGINEERING & SALES COMPANY, of New York, N. Y., has been incorporated with a capital stock of $200,000 by C. Griswold, W. S. Jewell and J. L. Beese, Jr., of New York, N. Y. The company proposes to manufacture and deal in motor vehicles, engines, etc.

THE ROSS-SCHOFIELD COMPANY, of New York, N. Y., has been chartered by Robert D. Jeffreys, George Surand, 39 Cortlandt Street, New York, N. Y., and Charles I. Friedman, 104 Ten Eyck Street, Brooklyn, N. Y. The company is capitalized at $5,000 and proposes to manufacture boilers, mechanical implements, etc.

THE SANITARY VACUUM CLEANING & POWER COMPANY, of Brooklyn, N. Y., has been incorporated with a capital stock of $100,000 for the purpose of manufacturing vacuum-cleaning apparatus, etc. The incorporators are: J. A. Marshall, R. G. Barclay and A. W. Stevens, of Brooklyn, N. Y.

THE SIMMONS AUTOMOBILE COMPANY, of New York, N. Y., has been incorporated with a capital stock of $10,000 by John G. Simmons, 2138 Westchester Avenue; George L. Lewis, 42 Broadway, both of New York, N. Y., and Daniel E. Wing, of Hackensack, N. J. The company proposes to manufacture and sell motors, engines, automobiles, etc.

THE UNIVERSAL CARBON COMPANY has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $500,000. The incorporators are: F. L. Palmer, E. L. Kirkham and E. A. Taylor, of Hartford, Conn.

THE VOHR SALES COMPANY, of Chicago, Ill., has been chartered with a capital stock of $2,500 by Dwight B. Cleaver, George L. Cragg and Max I. Rosenberg. The company proposes to manufacture electrical machinery and supplies.

New Incorporations.

LEESBURG, IND.—Articles of incorporation have been filed for the Leesburg Light & Water Company, with a capital stock of $10,000, by Frank Bortz, W. H. Stanley, W. A. Kohler, H. E. Kunz and Charles Gawthrop. The company proposes to construct and operate water and light plants.

PINE CITY, MINN.—The Eastern Minnesota Power Company has been incorporated with a capital stock of $200,000 by J. J. Flynn, John C. Carlson, of Rush City, Minn., and others.

MEXICO, MO.—The St. Louis, St. Charles & Northern Traction Company has been chartered with a capital stock of $900,000 by R. E. Race, of Mexico, Mo.; R. M. Hendershott and C. Pearson, of Middletown, Mo. The company proposes to construct and operate an electric

railway to extend through St. Charles, Lincoln, Pike, Montgomery and Audrain Counties. The proposed road will be seventy-seven miles long.

OMAHA, NEB.—The Omaha & Western Iowa Traction Company has been chartered with a capital stock of $250,000 for the purpose of constructing an electric railway, ninety miles in length, from Omaha, Neb., to Sioux City, Ia., by the way of Council Bluffs. The cost of construction is estimated at $20,000 per mile.

RANSOMVILLE, N. Y.—Articles of incorporation have been filed for the Ransomville Electric Light, Heat & Power Company by F. D. McCormick, J. W. Thompson, A. H. Hoffman and G. E. Hubble, of Ransomville, N. Y. The company is capitalized at $25,000, and proposes to supply electricity and gas for lamps, heat and power. The company is located at Porter, N. Y., not a post office.

DEFIANCE, OHIO.—The Defiance Interurban Railway Company has filed articles of incorporation with a capital stock of $50,000 to build an electric railway to extend from Defiance, Fort Wayne, Ashwood, Emmett, Cecil, Paulding, Antwerp and New Haven. The officers are: K. V. Haymaker, of Defiance, Ohio, president; Charles E. Bennett, of Wausen, vice-president; T. C. Jacks, of Defiance, secretary and general manager, and Robert C. Holgate, of Defiance, treasurer.

ELIZABETH, PA.—The Glassport & Elizabeth Railway Company has been incorporated by Jacob Ulrich, of McKeesport, Pa.; W. T. Fuether, D. J. Altman, H. G. Altman and C. A. McGrew, all of Glassport, Pa. The company is capitalized at $18,000, and proposes to construct an electric railway, three miles long, to connect Glassport and Elizabeth.

ALTA, UTAH.—Articles of incorporation have been filed for the Alta & Jordan Valley Railway Company, with a capital stock of $200,000, for the purpose of constructing an electric railway from Sandy to Alta, a distance of sixteen miles. The incorporators are: B. F. Cummings, W. F. Cummings, M. A. Williams, D. J. Williams and E. W. Cummings.

Personal.

MR. HENRY G. REIST, of the General Electric Company, Schenectady, will deliver on Dec. 2 the address at the fourteenth anniversary of Founders' Day of the Thomas S. Clarkson Memorial School of Technology, Potsdam, N. Y.

MR. R. I. JONES, formerly with Allegheny Light Company, and later in the interests of the Excess Indicator Company, at Altoona, has taken a position as contract agent for the Lewistown district of the Penn Central Light & Power Company.

PROF. F. W. SPRINGER, director of the electrical engineering laboratory at the University of Minnesota, at Minneapolis, has received a year's leave of absence from his university work to visit technical and engineering colleges in Germany and France, where he is now studying laboratory methods, and will give the Minnesota school the benefit of his observations on his return next year.

MR. LYNN A. WILLIAMS, a Chicago patent lawyer with a wide acquaintance among electrical men, was elected president of the University of Wisconsin Club in Chicago at the recent annual dinner of that organization. This gathering took the form of an "aviation meet," and the alumni, among whom the engineers are particularly active, enjoyed themselves to the top of their bent.

MR. H. G. CHATAIN, of the General Electric Company, will on December 2 address the Electrical Engineering Society of Columbia University on the subject of "Gas-Electric Cars." The meeting will be held at the Engineering Building of the university.

DR. ERNEST J. BERG, professor of electrical engineering at the University of Illinois, presented a paper entitled "Surging of Synchronous Machines" before the Western Society of Engineers, at Chicago, on November 23.

MR. H. W. CHASE has resigned as manager of the "New Business" department of the Union Gas & Electric Company, of Cincinnati, to join the Central Station Development Company, Cleveland. Mr. Chase has had long and varied experience in "new business" departments of central stations, having first entered this line of work with the American Light & Traction Company, of Binghamton, N. Y., conducting a gas campaign. Shortly after he was employed by the Henry L. Doherty Company, taking up work at Lebanon, Pa. While there Mr. Chase conceived the idea of arranging a display of gas appliances in each of the three city market houses, and giving demonstrations each market day. This plan proved very beneficial and a large number of gas appliances were sold as a result. Later, at Denver, he acquired his electrical education and experience. He then took up the work of organizing a "new business" department in the Union Gas & Electric Company of Cincinnati, and was later appointed manager of one of the divisions of that company. Shortly afterward he was employed by the Dayton Lighting Company, of Dayton, Ohio, in charge of its "new business" department, and in a very short space of time, through his progressive business methods, sold 1600 electric irons at a profit. He served the Dayton Lighting Company for about two and a half years, and again took up the work of the Union Gas & Electric Company of Cincinnati, in charge of its "new business" department, and remained with that company until his appointment by the Central Station Development Company. Mr. Chase will probably have charge of the Central Station Development Company operations in the State of New York.

Obituary.

MR. E. A. BECK, general superintendent of the Pacific Light & Power Company, Los Angeles, Cal., died on Nov. 11. Mr. Beck had been identified with the upbuilding of Southern California for many years. Twelve years ago, when the San Gabriel Electric Company was formed, he engaged actively in the construction of its first lines.

MR. OCTAVE CHANUTE, a distinguished civil engineer, who has been styled "the father of aviation," died at his home in Chicago on Nov. 23, aged seventy-eight. He was born in France, but was brought to the United States by his parents when he was six years old. For many years he was engaged in engineering work for railroads, and in 1889 he established himself as a consulting engineer in Chicago. In 1891 he was president of the American Society of Civil Engineers, and ten years later served as president of the Western Society of Engineers. He was also a member of several other engineering societies. He made a study of methods of wood preservation and engaged in the business of preserving ties on a commercial scale. He became interested in the study of mechanical flight as long ago as 1874, but as this "side issue" interfered with his regular professional work, he laid it aside until 1888, when he was in a position to give more time to it. Several years later he conducted a department in the *American Enquirer* in the interests of aviation, contributing practically all of the matter contained, which was reprinted in book form in 1894. He was wont to call flying the hobby of his old age, but persons conversant with the development of aviation give credit to him more than to any other man for hastening the conquest of the air.

Trade Publications.

WATT-HOUR METER CALIBRATORS.—Portable watt-hour meter calibrators for use with alternating-current instruments are described fully in Bulletin No. 1124, of the Fort Wayne Electric Works, Fort Wayne, Ind.

ICE MACHINERY.—The Triumph Ice Machine Companies, Cincinnati, Ohio, have issued, as a souvenir of the inspection trip of Cincinnati's Commercial Organization to their plant, a well-illustrated booklet, giving numerous views of the buildings in which is manufactured ice machinery for industrial and domestic purposes.

DIRECT-CURRENT GENERATORS.—Bulletin No. 1121 of the Ft. Wayne Electric Works, Fort Wayne, Ind., gives an outline of the construction of direct-current generators, ranging in rating from 1 kw to 75 kw. These machines are provided with either shunt or compound windings and are of either the open or inclosed type.

BLOWERS FOR HOT-AIR FURNACES.—The Emerson Electric Manufacturing Company, St. Louis, Mo., has developed for the market an electric-motor-driven blower for use with hot-air furnaces. By means of such a blower the hot air may be driven to any portion of the house, quite independent of the external air pressure. These blowers are described in Bulletin No. 3310.

MOTOR INDUSTRIAL APPLICATIONS.—Messrs. Dick, Kerr & Company, of Abchurch Yard, Cannon Street, London, have just issued an interesting pamphlet showing their electric motor as applied to various industries. It is illustrated in use on various types of pumps, driving paint mixers, machinery in textile mills, on various forms of machine tools, printing presses, compressors, etc. The book is well illustrated and the motors thoroughly well described.

WATT-HOUR METERS.—An instructive pamphlet (Circular 1137) on the principles of construction and operation of watt-hour meters has just been issued by the Westinghouse Electric & Manufacturing Company. Though in the form of a descriptive circular, the pamphlet goes at some length into the question of rates and the theory of meters, and points out the importance of the various features and adjustments of modern meters, both alternating and direct-current. The pages on "Selection of Watt-hour Meters," for example, bring out useful points often lost sight of. Descriptions are given of the latest style of Westinghouse induction watt-hour meters, with micrometer light-load adjustment and permanent magnets so arranged as to be really permanent, both in position and strength. The "ball and jewel" type of bearing and other features are described and illustrated, and also a method of meter testing without the use of a stop watch.

BUSINESS NOTES.

THE ROYSE ELECTRIC COMPANY, of Indianapolis, Ind., has recently reorganized and changed its name to the Indianapolis Electrical Supply Company.

THE TUNGSTOLIER COMPANY has moved its offices from Cleveland to Conneaut, Ohio, following the purchase of the Conneaut Fixture Company. The Tungstolier Company has now united in its organization, in addition to the above company, the Cleveland Gas & Electric Fixture Company and the Pennsylvania Gas & Electric Fixture Company.

ROSSITER, MACGOVERN & COMPANY, 90 West Street, New York, have not moved their offices to Claremont and Mallory Avenues, Jersey City, as stated in a recent note in these columns. Nor has there

been any change in the location of the warehouses of the company, which are at West Side Avenue station, C. R. R. of N. J., Jersey City.

THE PITTSBURGH ENGINEERING AGENCY has formed a business company to take over the foreign and domestic work of the Associated Bureau Service, comprising bureaus of technical reference, engineering research, industrial commissions and American trade catalogs. Offices will be opened in the Investment Building, Pittsburgh, Dec. 1. The aim of the organization is to develop an effective central clearing house of technical intelligence and service.

RAILWAY SWITCHBOARDS.—The General Electric Company is building for the Galveston-Houston Electric Railway Company (Stone & Webster, constructing engineers) four switchboards, complete with the entire equipment, including meters, instruments, electrolytic lightning arresters, disconnecting switches and oil switches. One board of ten panels will go in the main station and one of six panels in substation No. 2, which is located in the main station. In substations No. 1 and 3, which are each fourteen miles distant from the main station, there will be a switchboard of six panels. The power will be generated at 2300 volts, transmitted at 33,000 volts and used in railway work at 600 volts after going through rotaries in the substations.

TRIUMPH ELECTRIC COMPANY.—Among the recent sales of the Triumph Electric Company of Cincinnati are the following: One 600-kw direct-connected generator, Factory Power Company, Oakland, Ohio; one 175-kw and one 125-kw, 2300-volt alternator, Cincinnati University; one 200-kw direct-current generator, Breese Trenton Coal Company; one 150-kw generator, one 100-hp and one 50-hp and several smaller motors, Marrowbone Coal & Coke Company; two 150-kw, three-wire generators, Bay View Hospital; one 100-kw and one 50-kw three-wire generator, Westinghouse, Church, Kerr Company; one 125-hp variable-speed motor, A. C. Spalding Bros.; one 100-kw and one 50-kw, three-wire generator, Missouri Pacific Railroad Company; one 150-hp, variable-speed motor, H. T. Lloyd, Spokane, Wash.; one 150-hp motor, Belle-view Mines, Alberta, Can. The company has also sold quite a large amount of apparatus of smaller sizes than those mentioned above. It reports an increased number of inquiries and a decided improvement in the small motor business.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

Alabama Light & Traction Association. Secretary, Geo. S. Emery, 11 N. Royal St., Mobile, Ala.

American Association of Electric Motor Manufacturers. Secretary, W. H. Tapley, Engineering Societies Building, 29 West 39th St., New York.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa. Next semi-annual meeting, New York City, April or May, 1911.

American Electro-Therapeutic Association. Secretary, Dr. J. Willard Travell, 27 East 11th St., New York.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, Engineering Societies Building, 33 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September.

American Street & Interurban Railway Accountants' Association. Secretary, H. E. Weeks, Davenport, Ia.

American Street & Interurban Railway Engineering Association. Secretary, Norman Litchfield, Interborough Rapid Transit Company, New York.

American Street & Interurban Railway Association. Secretary, H. C. Donecker, Engineering Societies Building, 29 West 39th St., New York.

Arkansas Association of Public Utility Operators. Secretary, J. E. Cowles, Little Rock, Ark.

Association of Iron and Steel Electrical Engineers. Secretary, John Farrington, Steubenville, O.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, 135 Adams St., Chicago. Next meeting, Boston, Mass., June, 1911.

Association of Railway Electrical Engineers. Secretary, J. Andreucetti, Chicago & Northwestern Railway, Chicago. Next annual meeting, Chicago, November, 1911. Semi-annual meeting, Washington, 1911.

Association of Edison Illuminating Companies. Secretary, N. T. Wilcox, Lowell, Mass.

Canadian Electrical Association. Secretary, T. S. Young, 104 Confederation Life Building, Toronto, Ont.

Canadian Street Railway Association. Secretary, Allen H. Royce, 48 King St., W., Toronto, Ont.

Central Electric Railway Association. Secretary, A. L. Neereamer, Indianapolis, Ind. Next meeting, Dayton, Ohio, Dec. 1, 1910.

Chicago Electrical Show. Manager, H. E. Niesz, 150 Michigan Boulevard, Chicago. Next show, Jan. 7-21, 1911.

Cleveland Engineering Society. Secretary, F. W. Ballard, 413 Chamber of Commerce Building, Cleveland, Ohio. Regular meetings second Tuesday of each month, except July, August and September. Annual meetings second Tuesday of June each year.

Colorado Electric Light, Power & Railway Association. Acting Secretary, F. D. Morris, 323 Hagerman Building, Colorado Springs, Col.

Eastern States Independent Telephone Association of Pennsylvania, New Jersey, Maryland and Delaware. Secretary, H. E. Bradley, 135 South Second St., Philadelphia, Pa.

Electric Vehicle Association of America. Secretary, Harvey Robinson, 124 West 42d Street, New York.

Electric Club, Chicago. Secretary, F. S. Hickok, 824 Marquette Building, Chicago. Meets every Wednesday noon, 303 Wabash Ave.

Electric Contractors' Association of New York State. Secretary, Geo. W. Russell, Jr., 25 West 42d St., New York. Next meeting, Albany, N. Y., Jan. 17, 1911.

Electric Trades Association of Philadelphia. Secretary, J. W. Crum, 1324 Land Title Building, Philadelphia, Pa. Meetings, second and fourth Thursday of each month.

Electrical Contractors' Association of State of Missouri. Secretary, Ernest S. Cowie, 1413 Grand Ave., Kansas City, Mo.

Electrical Salesmen's Association. Secretary, Francis Raymond, 125 Michigan Ave., Chicago. Annual meeting, Chicago, January, each year.

Electrical Trades Association of Canada. Secretary, William R. Staveley, Royal Insurance Building, Montreal, Can.

Electrical Credit Association of Chicago. Secretary, Frederic P. Vose, Marquette Building, Chicago.

Electrical Trades Association of the Pacific Coast. Secretary, Albert H. Elliott, Harding Building, 34 Ellis St., San Francisco, Cal. Monthly meeting, San Francisco, second Thursday of each month.

Electrical Trades Society of New York (Member National Electrical Credit Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of directors meets second Thursday of each month.

Empire State Gas & Electric Association. Secretary, Charles H. B. Chapin, Engineering Societies Building, 29 West 39th St., New York.

Engineering Society of Wisconsin. Secretary, W. G. Kirchoffer, 31 Vroman Building, Madison, Wis.

Engine Builders' Association of the United States. Secretary, C. H. Lembower, Reading, Pa.

Florida Electric Light & Power Association. Secretary, H. C. Adams, West Palm Beach, Fla. Next meeting, Jacksonville, Fla., April 4 and 5, 1911.

Illinois State Electrical Association. Secretary, H. E. Chubbuck, Peoria, Ill.

Illuminating Engineering Society. Secretary, P. S. Millar, Engineering Societies Building, 29 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago. Annual convention, Chicago, 1911.

Independent Electrical Contractors' Association of Greater New York. Secretary, L. H. Woods, 2355 Jerome Ave., New York.

Independent Telephone Association of Southern Indiana. Secretary, E. W. Landgrebe, Huntington, Ind.

Indiana Electric Light Association. Secretary, J. V. Zartman, Indianapolis, Ind.

Internal Combustion Engine Association. Secretary, Chas. Kratch, 416 W. Indiana St., Chicago. Meetings, second Friday of each month.

International Association of Municipal Electricians. Secretary, C. R. George, Houston, Tex. Next meeting, St. Paul, Minn., 1911.

International Electrotechnical Commission (international body representing various national electrical engineering societies contributing to its support). Secretary, C. le Maistre, 28 Victoria St., Westminister, London, S. W., England.

National Independent Telephone Association. Secretary, A. C. Davis.

Iowa Electrical Association. Secretary, W. N. Keiser, Dubuque, Ia. Next meeting, Davenport, Ia., April 19, 20 and 21, 1911.

Iowa Independent Telephone Association. Secretary, W. J. Thill, 208 Des Moines Life Building, Des Moines, Ia. Annual meeting, second Wednesday in March each year.

Iowa Street & Interurban Association. Secretary, L. D. Mathes, Dubuque, Ia. Next meeting, Davenport, Ia., April, 1911.

Kansas Gas, Water & Electric Light Association. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Independence, Kan., Sept. 21 and 22, 1911.

Kentucky Independent Telephone Association. Secretary, James Maret, Mount Vernon, Ky. Regular meeting, second Tuesday in October, each year.

Maine Electrical Association. Secretary, Fred D. Gordon, Auburn, Maine.

Massachusetts Street Railway Association. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

Michigan Electrical Association. Secretary, A. P. Biggs, Detroit, Mich.

Minnesota Electrical Association. Secretary, B. W. Cowperthwait, Faribault, Minn.

Mississippi Electric Association. Secretary, J. A. Abbott, Jackson Railway & Light Company, Jackson, Miss.

Missouri Electric, Gas, Street Railway & Water Association. Secretary, N. J. Cunningham. Next meeting, St. Louis, April, 1911.

Missouri Independent Telephone Association. Secretary, G. W. Schweer, Windsor, Mo. Next meeting, St. Louis, May, 1911.

National Arm, Pit & Bracket Association. Secretary, J. B. Magers, Madison, Ind.

National District Heating Association. Secretary, D. L. Gaskill, Greenville, Ohio.

NATIONAL ELECTRIC CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 41 Martin Building, Utica, N. Y.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Executive Secretary, T. C. Martin, Engineering Societies Building, 33 West 39th St., New York.

NATIONAL ELECTRICAL INSPECTORS' ASSOCIATION. Secretary, T. H. Day, 27 Pliny St., Hartford, Conn. Next meeting, New York, March, 1911.

NATIONAL ELECTRICAL CREDIT ASSOCIATION. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago.

NEBRASKA ELECTRICAL ASSOCIATION. Secretary, Frank McMaster, Beatrice, Neb.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

NEW ENGLAND SECTION, NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, L. D. Gibbs, 39 Boylston St., Boston, Mass.

NEW ORLEANS ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, I. G. Marks, 312 Carondelet St., New Orleans, La. Meetings, second and fourth Tuesdays of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, Engineering Societies Building, 33 West 39th St., New York.

NORTHWEST ELECTRIC LIGHT & POWER ASSOCIATION. Secretary, N. W. Brockett, Cataract Building, Seattle, Wash.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Ralph Reamer, Columbus, Ohio.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL & STEAM ENGINEERS. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus, Ohio. Next meeting, May 18 and 19, 1911.

OKLAHOMA PUBLIC UTILITIES ASSOCIATION. Secretary, Galen Crow, Guthrie, Okla.

OLD TIME TELEGRAPHERS' & HISTORICAL ASSOCIATION. Secretary, F. J. Scherrer, 195 Broadway, New York. Next reunion, Atlantic City, N. J., 1911.

ORDER OF REJUVENATED SONS OF JOVE. Mercury (Secretary), R. M. Van Vleet, 1157 Monadnock Building, Chicago, Ill.

PACIFIC COAST ELECTRIC VEHICLE ASSOCIATION. Secretary, A. H. Halloran, 604 Mission St., San Francisco, Cal.

PENNSYLVANIA ELECTRIC ASSOCIATION. Secretary, Van Dusen Rickert, Pottsville, Pa.

PENNSYLVANIA STREET RAILWAY ASSOCIATION. Secretary, Charles H. Smith, Lebanon, Pa.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Col. Meetings, second Saturday of each month.

PITTSBURG ELECTRIC BOOSTER CLUB. Recording Wattmeter, O. R. Rombach, 919 Liberty Ave., Pittsburg, Pa. Meetings, fourth Monday of each month.

RAILWAY ELECTRIC SUPPLY MANUFACTURERS' ASSOCIATION. President, A. C. Moore, Safety Car Heating & Lighting Co., Chicago.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, H. H. Norris, Cornell University, Ithaca, N. Y.

SOCIETY OF WIRELESS TELEGRAPH ENGINEERS. Secretary, E. D. Forbes, Box 63, Brant Rock, Mass. Monthly meeting, first Monday of each month.

SOUTH DAKOTA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, E. R. Buck, Hudson, S. D. Next meeting, Redfield, S. D., Jan. 11 and 12, 1911.

SOUTHWEST ELECTRIC & GAS ASSOCIATION. Secretary, E. T. Moore, Dallas, Tex.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary C. G. Reel, Kingston, N. Y.

UNDERWRITERS' NATIONAL ELECTRICAL ASSOCIATION. Secretary Electrical Committee, C. M. Goddard, 141 Milk St., Boston, Mass. Next biennial meeting, March, 1911.

VERMONT & NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Lena M. Owen, St. Johnsbury, Vt.

VERMONT ELECTRICAL ASSOCIATION. Secretary, A. B. Marsden, Manchester Center, Vt.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 145 Monroe St., Chicago, Ill.

WESTERN SOCIETY OF ENGINEERS. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Friday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1, each year.

WIRELESS INSTITUTE. Secretary, Sidney L. Williams, 42 Broadway, New York.

WISCONSIN ELECTRICAL ASSOCIATION. A consolidation of the Northwestern Electrical Association and the Wisconsin Electric and Interurban Railway Association. Secretary, Johs S. Allen, Lake Geneva, Wis.

Weekly Record of Electrical Patents

UNITED STATES PATENTS, ISSUED NOV. 21, 1910.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

13,174. SECONDARY BATTERY; W. Morrison, Des Moines, Ia. App. filed May 26, 1909. A reversible battery with alkaline electrolyte with negative electrode containing zinc and mercury in contact with the zinc, the zinc being in excess of what the electrolyte will consume and being oxidized in the working of the battery.

976,151. ELECTRICAL SYSTEM OF DISTRIBUTION: R. N. Chamberlain and M. R. Shield, Lancaster, N. Y. App. filed Dec. 17, 1909. Train lighting system with generator and booster in series and charging circuit with batteries and work circuits and switches actuated by the current strength of the generator.

976,154. CONDUCTOR STRIP; H. B. Collier, Prairie Grove, Ark. App. filed Sept. 15, 1909. For burglar alarms in which conductor strips extend across the glass door or window and gum strips are pasted thereover, the conductor strips being foil.

976,159. ELECTRICALLY OPERATED SIGNALING HORN; E. M. Tormin, Newton, Mass. App. filed July 6, 1909. A horn with a casing on the inner end, a diaphragm between the horn and the casing, a hollow electro-magnet containing a plunger adjacent to the diaphragm.

976,162. LOCOMOTOR FOR USE IN CONDUITS; G. C. Fryer and E. Pfleiderer, Syracuse, N. Y. App. filed Aug. 11, 1906. A frame and motor with switch and cord to operate the switch from the outside of the conduit.

976,172. TROLLEY WHEEL; E. K. Harris, Canandaigua, N. Y. App. filed May 26, 1909. Grooved trolley wheel whose perpiphery consists of non-conducting resilient material with two ridges separated by a groove.

976,184. SERVICE METER SYSTEM; G. A. Joy, Chicago, Ill. App. filed April 6, 1908. A service meter with a cord circuit in the line, which meter is actuated after a conversation is terminated.

976,196. SUBSTATION CIRCUIT; J. J. Lyng, East Orange, N. J. App. filed March 11, 1909. Harmonic ringers are used with a condenser normally in the signaling circuit, but which may be connected to the talking circuit so that when the receiver is removed the capacity of the transmission circuit is altered.

976,207. FILAMENT OR RESISTOR FOR HEATING UNITS OR LAMPS; H. C. Parker, New York, N. Y. App. filed May 20, 1909. A non-metallic filament which is a conductor when cold and glows in the open air consisting of carbon solution in carborundum in a certain proportion.

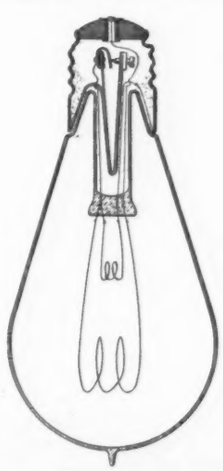
976,216. ELECTRICAL RELAY; F. Ritchie, Acton, Eng. App. filed Dec. 16, 1905. The action of the relay is reinforced by a local induced current so that it may be operated by a line current, a primary impulse being produced after the initial impulse which induces a secondary impulse in the same direction as the initial impulse.

976,230. TELEPHONE RECEIVER; H. R. Stuart, Newark, N. J. App. filed June 29, 1909. Telegraphone with feeble operative current in which the receiver includes a pair of solenoids, a pivoted armature, a diaphragm, a sound chamber on one side and a member extending from the diaphragm through the hole in the side of the chamber in a direction along its path of movement.

976,241. TELEPHONE TRUNKING SYSTEM; C. S. Winston, Chicago, Ill. App. filed Nov 17, 1906. A telephone trunk circuit, a source of ringing current, a periodically actuated relay for connecting the source with the talking strands, the relay being controlled from the outgoing end of the trunk and made inoperative automatically, depending upon the condition of the telephone of the called subscriber.

976,248. INCANDESCENT LAMP; G. F. Atwood, Newark, N. J. App. filed Jan. 3, 1910. The filament has its ends coiled around the supports and united thereto.

976,277. ELECTROLYTE FOR ALKALINE BATTERIES; W. Morrison, Des Moines, Ia. App. filed May 6, 1909. A reversible battery with a zinc negative pole and an alkaline electrolyte containing an oxygen compound which renders the zinc insoluble.



976,297.—Automatically Flashing Electric Lamp.

976,278. PROCESS OF MANUFACTURING MATERIAL FOR ALKALINE BATTERIES; William Morrison, Des Moines, Ia. App. filed September 26, 1910. Combines suitable quantities of zinc oxide, chromium sulphate and an alkaline solution from which a compound of zinc and chromium is precipitated.

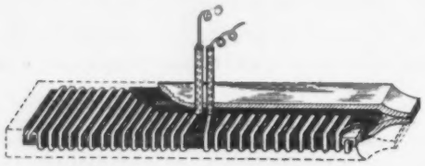
976,279. PROCESS FOR MAKING MATERIAL FOR ALKALINE BATTERIES; W. Morrison, Des Moines, Ia. App. filed Oct. 10, 1910. Produces electrolytically a compound containing zinc chromate in an alkaline electrolyte.

976,297. AUTOMATICALLY FLASHING ELECTRIC LAMP: W. J. Phelps, Detroit, Mich. App. filed July 16, 1903. Two filaments of different candle power in series and a thermostat operated by the heat of the filaments to control the short circuit around the low-power filament.

976,298. SELECTIVE PARTY LINE TELEPHONE SYSTEM; H. J. Roberts, Evanston, Ill. App. filed Sept. 18, 1902. A pair of line wires from central through the subscribers' stations, one line in section and the other continuous and a bridging connection between the sectional line and continuous line at each substation, together with a relay in a grounded branch at each substation to restore the line connections.

976,319. PROTECTIVE COATING FOR CARBON BODIES; Hermann Viertel, Lichtenberg, near Berlin, Germany. App. filed May 26, 1910. For wet electrolysis in which the electrode consists of a carbon body with a protected layer of silit (a silicon compound).

976,380. SELECTIVE SIGNALING SYSTEM; O. M. Leich, Genoa, Ill. App. filed Dec. 10, 1908. Railroad telephone system with step-by-step signaling mechanism and a slower moving clock mechanism which overtakes the step-by-step mechanism to change the circuit conditions through the local signal.



976,404.—Electric Heater.

976,404. ELECTRICAL HEATER; M. H. Shoenberg and G. T. Marsh, San Francisco, Cal. App. filed Jan. 28, 1909. A single conducting core of solid metal, with a conducting resistance coil wound about the core, with insulation between core and coil and a closed, seamless tube compressed upon the outside of the insulation, the coil at one end connecting to the core and at the other with the terminal.

976,405. ELECTRIC HEATER; M. H. Shoenberg, San Francisco, Cal. App. filed June 1, 1910. A casing open at both ends, with a tubular handle at right angles and a tubular spool within the casing, a cavity between the spool and casing closed at both ends and a high resistance wire upon the spool.

976,420. DYNAMO ELECTRIC MACHINE; R. B. Williamson, Milwaukee, Wis. App. filed April 17, 1909. Turbo-alternator cooled by forced draft, the housing having ribs with ventilating openings and separable adjustable dampers with blowers on the rotor.

996,422. ELECTRIC SWITCH; J. H. Wooll, San Francisco, Cal. App. filed Oct. 29, 1909. A double-throw switch with contacts and independently mounted blades on insulating supports with an insulating structure connecting the blades operated by an independent level.

976,445. TROLLEY HEAD; E. E. Duff, Seattle, Wash. App. filed Aug. 11, 1909. A spring-pressed fork to surround the wheel and embrace the trolley wire should the wheel leave the wire.

976,454. ELECTROLYTE FOR DEPOSITING COPPER; W. G. Grey and W. Griffith, Pittsburgh, Pa. App. filed Feb. 23, 1910. Comprises a solution of copper sulphate, cyanid of potassium and bi-sulphite of soda.

976,457. TELEPHONE MOUTHPIECE; J. A. Hall, Oakland, Cal. App. filed Feb. 10, 1910. Disinfectant mouthpiece including a shell with a flared intermediate portion upon a straight outer end, a contracted inner end carrying fingers; the outer ends are perforated and surrounded by a circular path.

976,500. WIRELESS TELEGRAPHY; F. G. Sargent, Graniteville, Mass. App. filed Aug. 26, 1905. A coherer in which the tube is an elastic non-conducting tube with electrodes in the opposite ends.

976,501. TROLLEY POLE; P. Schnell, Philadelphia, Pa. App. filed Feb. 11, 1910. The trolley pole is kept upright by two side guy wires containing springs.

976,519. ELECTRIC LAMP SOCKET; J. S. Stewary, New York, N. Y. App. filed March 19, 1910. A cap and shell with bayonet joint connection. Details.

976,524. AUTOMATIC TELEPHONE SYSTEM; H. G. Webster, Chicago, Ill. App. filed March 6, 1909. Makes use of first selectors, second selectors and connectors proportionate to the numbers of simultaneous calls to be expected with automatic means for interconnecting the first selectors interchangeable with the calling lines, which are divided into groups of one hundred.

976,526. MANUFACTURE OF ELECTRIC FILAMENTS; C. A. Von Welsbach, Vienna, Austria-Hungary. App. filed Aug. 9, 1898. A filament consisting of osmium in a dense coherent and elastic condition incandescing at a temperature at which platinum volatizes.

976,527. MANUFACTURE OF ELECTRIC FILAMENTS; C. A. Von Welsbach, Vienna, Austria-Hungary. App. filed Aug. 9, 1898. A metallic filament consisting in associating an organic thread with osmium, then giving a dry distillation, then eliminating the carbon by the electric current in a suitable atmosphere.

976,528. MANUFACTURE OF ELECTRIC FILAMENTS; C. A. Von Welsbach, Vienna, Austria-Hungary. App. filed Aug. 9, 1898. The filament is connected to leading-in wires by a connecting body of osmium cement, which stands a high temperature.

976,532. ELECTRIC CONNECTING DEVICE; H. C. Wirt, Schenectady, N. Y. App. filed April 28, 1908. For joining the ends of conductors to contacts on cut-outs by means of a terminal connector engaging the wire at one end and extending into the space between the arms of the contact slip at the other end.

976,537. TELEGRAPH TRANSMITTER; J. C. Barclay, Montclair, N. J. App. filed March 22, 1909. A rotary member with the projecting studs occupying different paths of rotation and distributed angularly, the studs having plugs screwed into the member, the plugs being stepped and beveled, together with finger keys which operate mechanism to stop the rotary member, the latter controlling circuits.

976,549. SWITCH; H. W. Cheney, Norwood, Ohio. App. filed October 22, 1906. Oil switch for high voltage and large amperage without danger of injuring the operator, including means for supporting and moving the oil tank, which is operated by screw bolts to shift the tank.

976,562. ELECTRIC ALARM AND CALL BELL SYSTEM; J. H. Field, Victoria, B. C., Can. App. filed Jan. 25, 1909. An indicator and switch with line wires, one line wire open and an auxiliary line wire and translating device in the latter whereby the switch may close the normally open circuit without affecting the translating device of the closed circuit.

976,578. POLICE SIGNAL DEVICE; E. J. Kingsley, J. Greene and William G. Sadleir, Salt Lake City, Utah. App. filed Dec. 13, 1907. For signaling from central police station to the beat by means of a signal arm and driving mechanism controlling a source of current and light.

976,586. RELAY MAGNET; J. F. McElroy and J. E. Macomber, Albany, N. Y. App. filed May 13, 1910. A magnet with a sheet metal armature carrying a sheet metal loop to which a contact piece is loosely secured.

976,615. ELECTRIC RADIATOR; J. A. Tupper, Montpelier, Ia. App. filed Aug. 31, 1909. Resistance coils in circuit heat the liquid in the heater.

976,616. MANUFACTURE OF ELECTRIC FILAMENTS; C. A. Von Welsbach, Vienna, Austria-Hungary. App. filed Aug. 9, 1898. A filament for a lamp consisting of metal, deposited upon a filet in a series of layers, particularly osmium, the layers being united by raising the temperature.

976,617. RAIL-BOND; E. M. Weaver, Jamaica, N. Y. App. filed July 20, 1910. A main body of stranded wire has an outer armor of larger wire than the inner wire.

976.617.—Rail-Bond.

976,645. ELECTRICAL FIRE ALARM SYSTEM; J. H. Field, Victoria, B. C., Can. App. filed Feb. 3, 1909. An alarm bell and battery in series therewith, with thermostats in circuit with battery and bell and a master thermostat making the other thermostats inoperative when a general rise in temperature occurs.

976,654. ELECTRICAL SWITCH; J. D. Hilliard, Albany, N. Y. App. filed July 26, 1907. An oil switch in which the shock due to the initial formation of gases and pressure on the walls of the chamber containing the fixed electrode is absorbed by means of an oil pot with two chambers, one containing the fixed electrode with expansible walls.

976,670. END RING FOR INDUCTION MOTORS; H. Maxwell, Schenectady, N. Y. App. filed Feb. 28, 1910. Squirrel-cage induction motor with a cast end ring, with integral connecting members, each member doubled back on itself.

976,728. TROLLEY FOR ELECTRIC CARS; A. Del Valle, New York, N. Y. App. filed July 5, 1910. A finder for trolleys consisting of a fork pivoted near the upper fork of the trolley with a weight between the sides near the lower ends for stability.

976,743. LIGHTING AND BATTERY CIRCUITS; J. F. McElroy, Albany, N. Y. App. filed April 29, 1910. A normal circuit for car lighting with a battery and switch with a relay in the normal circuit controlling the switch and a charging switch, so that the battery may be thrown in the normal circuit for charging without interfering with the relay which controls the lamp circuit.

976,747. BATTERY TEMPERATURE CONTROLLER; F. W. Schmidt, Philadelphia, Pa. App. filed Jan. 13, 1910. For controlling current during the charging of a storage battery, so as to discontinue the charge by an automatic switch, controlled by a thermostat circuit when the temperature of the battery reaches a predetermined point.

976,748. CONTROL FOR CHARGING STORAGE BATTERIES; F. W. Schmidt, Philadelphia, Pa. App. filed May 4, 1910. For cutting out the charging circuit when the storage battery reaches a given temperature by means of a thermostat, having an electrically conducting acid-resisting metal casing and an appertured insulating jacket inclosing the casing.

976,749. THERMOSTAT; F. W. Schmidt, Philadelphia, Pa. App. filed Aug. 8, 1910. For charging storage batteries dependent upon the temperature in which the thermostat is inclosed with an acid-resisting casing and immersed in the solution of the apparatus.

976,750. CONTROL FOR CHARGING STORAGE BATTERIES; F. W. Schmidt, Philadelphia, Pa. App. filed Aug. 8, 1910. For cutting out the charging circuit on rise of temperature by means of electromagnetic retainer, together with a thermostat, the latter being immersed in the battery solution.

976,778. APPARATUS FOR PRODUCING AND UTILIZING ELECTRIC CURRENTS OF HIGH PERIODICITY; S. G. Brown, London, Eng. App. filed Dec. 17, 1906. An arc between carbon poles when shunted by a capacity and inductance is used to give oscillations of several thousand per second.

976,779. APPARATUS FOR TREATING SUGARCANE AND SIMILAR SUBSTANCES; G. D. Burton, Boston, Mass. App. filed Oct. 17, 1906. An revoluble receptacle with mixing devices, an electrode at each end, and a tank in which the receptacle is revolved, supplied with a solution by a pipe, and also steam heated.

976,780. PROCESS OF MANUFACTURING ICE CREAM, SHERBET, ETC.; G. D. Burton, Boston, Mass. App. filed Oct. 9, 1906. Places the ingredients in a revolving tank containing a freezing compound and subjects them to the action of an electric current.

976,791. STORAGE BATTERY ELECTRODE, T. A. Edison, Llewellyn Park, Orange, N. J., and J. W. Aylsworth, East Orange, N. J. App. filed April 28, 1905. A tubular perforated, non-active, inclosing pocket, made from metal of high tensile strength with flattened ends and active material compressed therein under pressure.

976,792. STORAGE BATTERY; T. A. Edison, Llewellyn Park, Orange, N. J. App. filed May 24, 1910. A conducting plate with pockets consisting of perforated tubes, side by side, of thin metal wound in opposite directions, and containing expansible highly compressed material.

976,824. GRID FOR REVERSIBLE GALVANIC BATTERIES; W. Morrison, Des Moines, Ia. App. filed Sept. 26, 1910. A pressed or stamped grid for electric batteries, using an alkaline electrolyte in which a plurality of plates hold the material between them and conducting projections extend into the material.